University of Alberta

An Ecological Analysis of Parasuicide

by

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Abstract

Parasuicide is an important public health concern, both in terms of its impact and in terms of its connection with suicide. In Alberta, parasuicide rates have been found to be high compared to other parts of the world.

Objectives:

1. Determine factors, at the ecological level, that are related to parasuicide in Alberta and to determine how those factors influence parasuicide.

2. To provide parasuicide statistics relevant to Alberta stakeholders.

Methods:

Parasuicide cases were collected from Alberta Health and Wellness' Ambulatory Care Classification System, and predictor variables were generated from the 1996 Statistics Canada Census. The ecological unit of analysis was the sub-Regional Health Authority.

Analysis:

A principal components analysis and linear regression were used to analyze the relationship between parasuicide and the census variables at the ecologic level.

Results:

Within a particular sub-Regional Health Authority, as social transience and overcrowding increased, and income decreased, the parasuicide rate increased.

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Chapter 1 – Introduction

1.1 Introduction

Suicide is one of Canada's leading causes of death. In fact, death by suicide is more common in Canada than death from motor vehicle collisions (Langlois & Morrison, 2002), HIV (CANSIM Database, 2003) or homicide (Langlois & Morrison, 2002). Suicide receives much less media attention than these causes, although it is responsible for more deaths than each and is many times more frequent than either HIV or homicide. In 1994, suicide was the second leading cause of death among Canadians aged 15 to 24 and the leading cause of death for males aged 25-39 (The Alberta Injury Data Report, 1996).

The major Statistics Canada (1999) most responsible causes of death were diseases of the circulatory system (78,942 deaths); neoplasms (62,769); diseases of the respiratory system (22,026); external causes, injury and poisoning (13,996) – which includes 2892 motor vehicle traffic accidents and 4074 suicides – diseases of the digestive system (7896); endocrine, nutritional and metabolic diseases and immunity disorders (7837); diseases of the nervous system and sense organs (6756); mental disorders (6672); and diseases of the genito-urinary system (3974). With 4074 deaths, suicide is obviously a large concern, even among the broadly defined major categories of death above (see Figure 1.1).

Few causes of death are as devastating for those left behind than suicide. Although there has been some debate recently, it is generally accepted that while

feelings of guilt and self-blame among family members are common in many causes of death, they are particularly salient surrounding suicide (Jordan, 2001; Ellenbogen & Gratton, 2001). Moreover, the stigma associated with suicide further burdens the families and friends of suicide victims (Tadros & Jolley, 2001; Ellenbogen & Gratton, 2001). Due to the sheer number of suicides and the emotional impact of suicide on families, suicide is obviously a very large public health concern.

Behaviour typically labelled "attempted suicide" is not always an attempt at death, as the term implies. Determining an individual's intent when presenting after deliberately harming themselves can be difficult and thus the term 'parasuicide', which will be fully defined in section 2.2.1, was introduced to capture the deliberate, self-inflicted nature of the injury, as well as the link with suicide, without making any claims as to the motivation for that injury. Parasuicide is associated with large numbers of hospitalization and emergency room visits (Langlois & Morrison, 2002), in addition to being an important risk factor for suicide. While parasuicide is certainly a risk factor for suicide, parasuicide has unique characteristics and is properly considered as different from unsuccessful suicide.

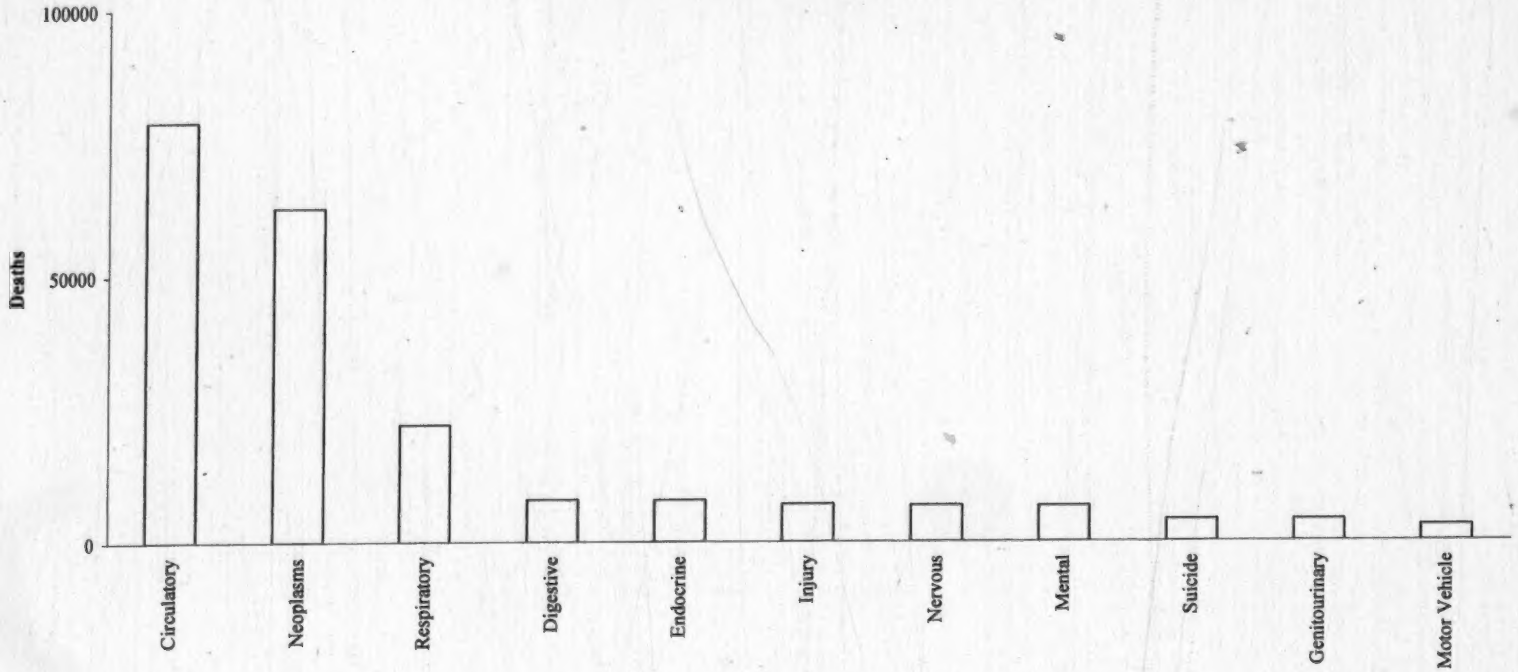
Suicide and parasuicide each present difficulties identifying events and contributing factors, and this makes studying these behaviours challenging. The factors that contribute to suicide in an individual are often only discernable from indirect sources, such as psychological autopsy studies. It is often difficult to be aware

of acts of parasuicide if the victims do not disclose the self-inflicted nature of their injury or do not present for medical attention.

Factors that contribute to suicide and parasuicide can differ contextually, depending on the distribution of individual characteristics. This makes it difficult to generalize findings from one region to others. For example, parasuicide is known to be dependent on age, gender and other sociodemographic and personal characteristics which will differ from region-to-region. However, the relationship between parasuicide and these variables is not understood to the point where parasuicide can be understood in a particular region by considering such characteristics.

The aim of the current study is to investigate the magnitude and demographics of parasuicide in Alberta and to make an attempt at understanding what factors are related to parasuicide at the ecological level. Thus, the present study will examine parasuicide ecologically in Alberta, Canada by comparing parasuicide rates to census data, such as unemployment rates, income and other sociodemographic information.

Figure 1.1 **Major Causes of Death in Canada (1999)**



Chapter 2 – Literature Review

2.1 Suicide

2.1.1 Definition and Data Collection

Suicide is typically defined as deliberate or intentional self-harm that results in death. While suicide is a behaviour and not a disease, we may use techniques employed to study disease to investigate suicide.

In Canada, suicide data have been recorded using the *International Classification of Diseases 9th revision* since 1979, with data obtained from death registration forms as supplied by the medical practitioner last in attendance or a medical examiner (Causes of Death Shelf Tables, 1999). While this method of identification captures nearly all deaths in Canada, suicide may not be accurately determined as the cause of death. For example, although suicide was de-criminalized in Canada in 1974, suicide might be less likely identified as the cause of death, so as to spare the family of the deceased social stigma and further grief. Suicides may also be unintentionally overlooked as a cause of death, in instances where accidental death due to injury or poisoning is a reasonable alternative. In some Canadian provinces, such as Newfoundland, low rates of suicide have often been attributed to such underreporting and although further examination revealed underreporting, it did not affect Newfoundland's rank among provinces (Sakinofsky, 1997).

Once suicide is determined as the cause of death, researchers may wish to identify associated factors. Often, only indirect methods of obtaining data regarding a

suicide victim's recent situation are available. Data from families or health records are often collected by researchers and coroners but these sources can be difficult to obtain or are unreliable.

2.1.2 Suicide Figures

The number of suicides in Canada in 2000 was 3605, with males accounting for 2798 suicides and females accounting for 807 (CANSIM Database, 2003). In 2001, the number of suicides was largely the same, at 3688 total suicides with 2869 in males and 819 in females (CANSIM Database, 2003). The number of suicides in Canada from 1989 to 2001 is shown in Figure 2.1. Suicides in males are typically three and a half times as common as suicides in females. This finding is consistent the world over, though the ratios may vary. In Denmark in 1993, the suicide ratio of males to females was 1.9:1, whereas in Ireland in 1992, the ratio was 5.1:1 (Cantor, 2000).

In Canada, before 1950, the female rate was rather constant compared to the more variable male rate, which was almost 5 times higher during the Depression and about 2.5 times higher during the Second World War. Since then, the male rate has been almost constantly 3.5 times that of the female rate, with both genders experiencing large increases in suicide rates beginning in 1960, peaking in the mid-to-late 1970s (Dyck et al., 1988), then decreasing somewhat in the 1980s (see Figure 2.2) and appearing to plateau throughout the 1990s.

The increase in rates beginning in 1960 was largely driven by increases in suicide among individuals aged 15 to 35 (Sakinofsky, 1997). In the UK, where a similar increase in suicide rates occurred, Klerman (1988) suggested that increased rates of depression were associated with the rise in suicide rates, while Simon and VonKorff (1992) pointed to higher rates of schizophrenia, anxiety disorders and alcohol misuse. Sakinofsky (1997) cautioned that it seems unlikely that an increase in the genetic prevalence of these disorders was responsible for the increase in rates and suggested social changes as a possible explanation. He commented that:

> After the Second World War Canada saw turbulent upheavals in long-standing norms and values within society, unprecedented attenuation of the bonds of the traditional nuclear family, a rise in prevalence and misuse of illicit psychoactive substances, a revolution in the collective consciousness of the role of women, and a higher profile for minority groups such as gays. In addition, the postwar baby boom (ending in the early 1960s) generated a larger birth cohort than preceded it, which had to be integrated into the institutions of society, the work force in particular. Each of these factors has been blamed for increasing suicide (p. 39).

From the time Canadian suicide data first became available in the mid-1920s, up until 1970, Canada and the United States had similar patterns of suicide, although Canada's suicide rate was typically much lower. The peak in suicide rates in the Depression and the drop in rates towards the end of the Second World War were seen in both countries. However, beginning around 1970, Canadian suicide rates rapidly outstripped American rates and have remained higher ever since (see Figures 2.3, 2.4 and 2.5). The US rate was approximately 11 suicides per 100,000 in 1970 and steadily

rose to about 12 per 100,000 in the 1980s and has since begun dropping towards 11 per 100,000 for the last seven or eight years (Suicide in Canada, 1997; WISQARS Database, 2003). In contrast, Canada's suicide rate in 1970 was climbing to 10 per 100,000 and by the 1980s, was roughly 15 per 100,000. Towards the end of the 1990's, although there have been signs of a slight decrease, the Canadian suicide rates have been fluctuating at around 13 per 100,000.

In Alberta, the pattern of rates of suicide has historically been similar to the overall Canadian rates, however, in general, Alberta's suicide rates tend to be higher than the average Canadian rates – and most other provinces' rates – particularly in males (see Figures 2.6, 2.7 and 2.8). In fact, in 1999 Alberta's suicide rate was the second highest among the provinces in Canada, second only to Quebec. From Figure 2.9, we see that Alberta's crude suicide rate for both males and females is the second highest among Canada's provinces. Also of note are the exceptionally high suicide rates in Canada's territories, particularly in males, however, the small populations in these territories result in large confidence intervals around the rate.

There were 477 suicides in Alberta in 2001, with 375 male suicides and 102 female suicides and in 2002, there were 441 suicides, with males contributing 351 and females contributing 90 (CANSIM Database, Office of the Chief Medical Examiner 2003). The suicide rate in Alberta for 2001 was 17.9 per 100,000 and in 2002 it was 16.2 per 100,000, compared with the crude suicide rates in Canada in 2001 of 13.5 and in 2002 of 13.2. The age-adjusted – to the 1991 Canadian population – suicide rates in

2001 for Alberta and Canada are 15.8 and 14.3, respectively, while in 2002 the rates were 11.9 and 11.6. Historically, the male suicide rate in Alberta has been 3 times that of the female rate (see Figure 2.10).

In Alberta, Edmonton has typically had a higher suicide rate than Calgary, with Edmonton having a higher rate than Calgary in every year from 1984 to 1996 (Colman, 2000). In Edmonton, for 2001 and 2002, the number of suicides was 127 and 113, respectively, and in Calgary, the number of suicides was 103 and 119, respectively (Office of the Chief Medical Examiner, 2003). The suicide rates for Edmonton in 2001 and 2002 were 13.2 and 11.5 per 100,000 and for Calgary the rates were 10.5 and 11.9. In the rates just provided, the suicide counts were based on Edmonton and Calgary city limits, while the populations were defined according to Statistics Canada Census Metropolitan Areas (CMA). As the CMAs for Edmonton and Calgary tend to include geographic areas outside civic city limits, the rates should be considered as approximations.

Generally, the suicide rate tends to increase with age, however, this pattern is changing in Canada as rates of suicide are increasingly high among the young, particularly 20-29 year old males, and are decreasing in older individuals, particularly females (Dyck et al., 1988; Langlois & Morrison, 2002). Much of the increase in suicide rates seen since the mid-1960s appears to be due to the rapid increase of rates in younger individuals, despite modest decreases in older Canadians.

2.1.3 Risk Factors Identified in Individual-level Studies

Among those who commit suicide, psychiatric illness is very common, particularly depression. As Lönnqvist (2000) illustrates in a summary of 12 psychological autopsy studies, depressive disorders were found in nearly half of all suicide victims and a mental disorder of some kind was present in approximately 90 per cent. The rate of suicide in depressed individuals has been frequently quoted as being 15 per cent (Guze & Robins, 1970) but this figure is in dispute, with more recent work suggesting that might be as low as 2.4% (Murphy et al., 1988). Lönnqvist (2000) also reviewed studies that examined the treatment of depression, finding that depression is often either not treated or not treated aggressively. Lack of treatment has also been found in studies investigating substance abuse among suicide victims (Murphy, 2000).

The risk of suicide in individuals diagnosed with schizophrenia has been estimated to be 20-40 times greater than in the normal population (Newman and Bland, 1991; De Hert & Peuskens, 2000). Within this group, suicides are more common between the ages of 20-35, often coinciding with the onset of the disorder.

Substance abuse, which includes alcohol, has also been regularly implicated in suicide, particularly when it is co-morbid with depression (Murphy, 2000). Unlike suicide in individuals with schizophrenia, suicide in substance abusers typically occurs relatively late in the disorder, usually between 10 and 20 years after the misuse began. Substance misuse has been said to be the second most frequent precursor to suicide

after psychiatric illness, particularly due to its effect on social support (Murphy, 2000) and because it is often co-morbid with mental disorders. Substance abuse in suicide victims is typically more frequent in males, yet it seems that when females do misuse substances, the effects are more devastating (Murphy, 2000).

Parasuicide is also an important risk factor for suicide. It has been said that of those who eventually commit suicide, 40 per cent have exhibited self-injuring behaviour previously (Kerkhof, 2000). Also, between 10 and 15 per cent of suicide attempters eventually die because of suicide (Maris, 1992). Bland et al. (1994) noted that, in Edmonton, 30 per cent of parasuicide patients are admitted to hospital and 47 per cent received a consultation from the Department of Psychiatry while in the emergency department. It seems obvious that effectively treating the psychiatric illnesses or suicidal ideation of parasuicide patients rather than only treating the self-inflicted injuries will go a long way towards reducing repeated parasuicide and fatalities due to suicide.

Socioeconomic factors, such as unemployment have also been shown to be related to suicide. Socioeconomic factors are difficult to examine as causes of suicide, since they are also related to mental disorders, age and gender. For example, a person who is severely mentally ill might be unemployable due to their illness and although unemployment may contribute to that individual committing suicide, it might only be a secondary factor. Also, socioeconomic factors are difficult to identify in individuals, since the data must come from indirect sources. However, Warr & Jackson (1987)

have found that, in men at least, it took nine months of unemployment before feelings of hopelessness set in and that after two years they became accustomed to their situation.

Single, separated or divorced individuals, particularly males, are overrepresented among suicide victims (Bland et al., 1994). Another identified Canadian risk factor includes being Aboriginal, where rates of suicide are two to four times higher than the general population (Sakinofsky, 1997).

2.1.4 Risk Factors Identified in Ecologic Studies

In ecological studies, researchers examine suicide across regions and compare the suicide rates with variables taken from readily available data sources, such as census data. At the ecological level, factors investigated with suicide can vary from study to study, although there are some factors that are often included and have been consistently shown to relate to suicide.

The relationship between suicide and unemployment has often been studied ecologically, with mixed and sometimes contradictory results (Crombie, 1990). In some cases, suicide and unemployment have been found to be positively related (Bagley et al., 1973) but this relationship is generally mediated by gender (Platt et al., 1992; Webb et al., 2002; Morrell et al., 1993; Pritchard, 1990). In addition, Webb et al. (2002) found that suicide was related to unemployment but that this was only the case when unemployment precedes suicide by one year. For males, suicide is often

related with unemployment, although it has been shown that this effect varies with age (Webb et al., 2002). In other studies, suicide and unemployment are found to be unrelated (Hasselback et al., 1991) or negatively related (Sakinofsky, 1987).

Other factors that have been studied and found to have a positive correlational relationship with high suicide rate in ecologic studies are overcrowding, high divorce rate, high rates of social services referrals, few owner occupied residences, low levels of education and lower economic status (McColloch, 1967; Bagley et al., 1973; Hasselback et al., 1991). Lester (1995) used factor analysis and found that a factor measuring social disintegration, according to Durkheim's theory of suicide, was consistently associated with rates of suicide.

It is difficult to place a high degree of confidence in results obtained from ecologic studies of suicide in terms of causal relationships, particularly due to the known importance of individual psychiatric illness. Most individuals that commit suicide have some form of psychiatric disorder (Platt, 1984). Attempts have been made to include mental illness in ecological studies but these measures are often crude (Buglass and Duffy, 1978). In addition, many of the ecological variables are often chosen arbitrarily or based on availability. This makes it difficult to compare results across studies and to form a firm understanding of the relationship between suicide and contributing ecologic factors. With ecological studies, there is always the risk of committing the ecological fallacy (Hennekens, 1987) and assuming that relationships that appear at the ecological level necessarily reflect relationships at the individual

level, which also limits the utility of ecological studies in determining causality. That said, ecological studies are particularly valuable in terms of identifying possible relationships and guiding individual-level studies.

2.1.5 Methods of Suicide

Methods of suicide are context-dependent and vary depending on age, gender, time period and region. Males tend to employ much more violent and potentially lethal methods, such as firearms, compared with women, where self-poisoning – whether by drugs or other substances, such as carbon monoxide from vehicle exhaust – is most common (Cantor, 2000). Sakinofsky (1997) provides data for overall methods in Canada for two periods, 1980-82 and 1990-92. In Canada, for males the most common method between 1980 and 1982 was firearms and explosives at 41 per cent and between 1990 and 1992, firearms and explosives were still the most frequent method at 36 per cent. However, between 1990 and 1992, hangings were the second most common method at 31 per cent, a 6 per cent increase since 1980-82. For females, between 1980 and 1982, self-poisoning was the most common method, accounting for 49 per cent of deaths. Between 1990 and 1992, the picture was largely the same, with self-poisoning accounting for 49 per cent of deaths.

In Alberta recently, data provided by the Office of the Chief Medical Examiner paints a somewhat different picture. In 2000, self-poisoning was the most common method (34 per cent) for males, followed by hanging (28 per cent) and firearms (28 per cent). In 2001, hanging (33 per cent) was the most common method for males,

followed by firearms (26 per cent) and poisoning and gas (26 per cent). For females in 2000, poisoning and gas was the most common method (48 per cent) with hanging (29 per cent) as the second most common method. In 2001, poisoning and gas were slightly more frequent (57 per cent) with hanging (27 per cent) relatively the same.

2.1.6 Summary of Suicide

Suicide is a leading cause of death and in Canada. In Alberta, the suicide rate is higher than in most provinces in Canada.

The sometimes conflicting results obtained from studies with different variables and selection criteria make the application of external results to the milieu of suicide in Alberta difficult. While, for the most part, ecological studies and individual-level studies tend towards the same risk factors, mediating variables such as age, gender, psychiatric illness and group-level ecologic factors (discussed in 2.2.6) also affect associations. As such, Alberta-specific studies are necessary to discover the factors that are relevant in the province.

2.2 Parasuicide

2.2.1 Definition

Like suicide, parasuicide is also a behaviour and not a disease. The term 'parasuicide' was introduced in order to avoid the intent to die implied the term 'attempted suicide'. The term 'attempted suicide' can be misleading, as it tends to lead one to conceptualize all acts of deliberate self-harm as unsuccessful suicides, however, it has been shown that deliberate self-harm does not necessarily imply suicidal intent (Kerkhof, 2000). In addition, while parasuicide can be predictive of suicide, the characteristics of suicide and deliberate self-harm are markedly different and this suggests that they be acknowledged as linked but separate behaviours.

Thus, parasuicide is recognized as related to suicide, yet distinct from unsuccessful suicide and is defined by Platt (1992) as:

> An act with non-fatal outcome, in which an individual deliberately initiates a non-habitual behaviour that, without intervention from others, will cause self-harm, or deliberately ingests a substance in excess of the prescribed or generally recognized therapeutic dosage, and which is aimed at realizing changes which the subject desired via the actual or expected physical consequences.

While Statistics Canada records the numbers of suicides in Canada by province, age group and gender in their yearly publications on causes of death, equivalent data on parasuicide is not available. Parasuicide data is difficult to obtain and can often be underreported as individuals may not reveal the parasuicidal nature of

their injuries when seeking medical attention or may never present to medical facilities. It has been suggested that in Edmonton, parasuicide is up to 20 times more common than suicide (Colman, 2000).

2.2.2 Parasuicide Figures

In Europe, a large study called the WHO/EURO Multicentre Study on Parasuicide, (Platt, 1992) was carried out comparing 16 well-defined catchment areas of at least 250,000 inhabitants. The mean female rate of parasuicide from 1989 to 1992 was 186 per 100,000, ranging from 69 per 100,000 in Guipuzcoa, Spain to 462 per 100,000 in Cergy-Pontoise, France. In males, the mean rate was 136 per 100,000, which ranged from 45 per 100,000 in Guipuzcoa, Spain to 314 per 100,000 in Helsinki, Finland. The data in the WHO/EURO Multicentre Study were obtained from study-specific monitoring forms filled out by medical personnel for parasuicides that were medically treated in general hospitals, other medical facilities and general practitioners.

Most studies of parasuicide in Canada rely on either emergency or inpatient facility data from administrative databases to identify parasuicide presenters. It is important to note that hospitalization is an insufficient estimator of actual parasuicide because most parasuicide patients are not hospitalized (Bland et al., 1998) and while presentation at an emergency department provides a better estimate, there are still many parasuicides that are likely never brought to medical attention. A report focusing on Alberta, found that for every death due to suicide, there were nearly seven hospitalizations due to parasuicide and over 17 visits to the emergency room (ACICR,

2001), while Bland et al. (1994, 1998) found that only 20-30 per cent of parasuicide presenters were hospitalized.

Langlois & Morrison (2002) investigated 1998/99 hospitalization data provided by the Canadian Institute for Health Information, which collects hospital data from all provinces. They found that the Canadian age-standardized hospitalization rate for parasuicide in females was 108 per 100,000 compared with 70 per 100,000 in males. Langlois & Morrison also found that Canada's overall age-standardized hospitalization rate for parasuicide was 88.8 per 100,000 and in Alberta, the rate was 99 per 100,000. Alberta ranked behind the Northwest Territories (219), the Yukon (169), Saskatchewan (123), British Columbia (120), New Brunswick (101) and Manitoba (101). Interestingly, Quebec had the lowest rate for hospitalization due to parasuicide (49) but had the highest rate of suicide among the provinces.

There have been studies that provide data based upon parasuicide patients in Edmonton presenting to the emergency department of hospitals. Bland et al. (1994) collected emergency data from University of Alberta Hospitals and found the parasuicide rate in Edmonton to be 448 per 100,000, which exceeded all cities in the WHO/EURO Multicentre Study (Platt, 1992). In a more recent study, Bland et al. (1998) found the overall parasuicide rate in Edmonton to be 376 per 100,000 based on emergency records from all Edmonton hospitals. When the Edmonton and WHO/EURO data were both age- and sex-standardized to the 1988 Canadian population, Edmonton's overall rate was 360 per 100,000 which exceeded the highest

overall rate in Europe – Cergy-Pontoise, France – of 335 per 100,000. When genders were compared, only Helsinki, Finland (322 per 100,000) had a higher male rate than Edmonton (297) and for females, only Cergy-Pontoise, France (454) had a higher rate than Edmonton (420).

Newman & Stuart (2005) found that Edmonton had an elevated parasuicide rate compared to Calgary. In both Edmonton and Calgary, the parasuicide rate decreased as average income increased.

2.2.3 Risk Factors Identified in Individual-level Studies

Psychiatric disorders are less common among those who engage in parasuicide compared with individuals who commit suicide. Langlois & Morrison (2002) noted that nearly half of the individuals in their study of hospitalized parasuicide victims had a mental disorder as their primary diagnosis, supporting the view that mental disorder is more common among suicide victims, where psychiatric illnesses are estimated at 90 per cent (Lönnqvist, 2000). However, individuals who engage in repeat parasuicide typically have a higher incidence of psychiatric illness (Kerkhof, 2000). As mentioned earlier in 1.1, details on psychiatric illness in those that have died by suicide are often obtained through psychological autopsy studies, which are retrospective and indirect methods of diagnosis.

Women are at greater risk than men for parasuicide and this has been shown repeatedly. Langlois & Morrison (2002) found that Canadian females had greater

hospitalization rates for parasuicide in every age category below 60 years of age, and after 60 years of age, male and female rates were essentially equal. The largest difference was in the 15-19 age groups, where males had a hospitalization rate of 87.3 per 100,000 and females had a rate of 220.8 per 100,000. In Edmonton, it was found by Bland et al. (1994) that females comprised 62 per cent of presenters to hospital. Additionally, the WHO/EURO Multicentre Study on Parasuicide (Platt, 1992) found that from 1989 to 1992, male parasuicide rates decreased on average by 17 per cent, while female rates increased by 14 per cent (Schimdke et al. 1996).

As alluded to above, parasuicide tends to vary with age, as well as gender. In Canada, Langlois & Morrison (2002) found that for males and females the patterns of hospitalization were similar but that rates were different. For males, hospitalization rates for parasuicide increased from 10 per 100,000 to 100 per 100,000 during adolescence, plateaued at 100 per 100,000 between the ages of 20-45, then by age 60 and up decreased to 25 per 100,000. For females, while the pattern is largely the same, the hospitalization rates are typically much higher. During adolescence, the female hospitalization rate begins at 70 per 100,000, rises to 220 per 100,000 and then plateaus between the ages of 20 to 45 at 130 per 100,000. Female hospitalization rates then decrease to 80 per 100,000 from ages 45 to 49 and eventually plateau at age 60 and up at 25 per 100,000. Bland et al. (1994) found a similar pattern with overall rates being high in youths, plateauing between the ages of 20-39, then decreasing during middle age and levelling off for older individuals. This pattern also agrees with data found by Bland et al. (1998).

Langlois & Morrison also determined that approximately nine per cent of individuals hospitalized for parasuicide had been discharged more than once for parasuicide that year. Kerkhof (2000) has stated that anywhere between 30 and 60 per cent of those that have committed parasuicide have previously committed parasuicide. The Bland et al. (1994) study found that in Edmonton, 41 per cent had a previous parasuicide.

Bland et al. (1998) also found that rates of parasuicide were far higher in single or separated/divorced individuals as compared to married and widowed individuals. This confirms results from the WHO/EURO study (Arensman et al., 1995).

Unemployment is often related to parasuicide as shown in a comprehensive review by Platt & Hawton (2000) but some studies have shown that controlling for family and childhood factors, as well as psychiatric disorders can reduce the association to non-significance (Beautrais et al., 1998). It remains to be seen whether or not the relationship between unemployment and parasuicide can repeatedly be explained by other mediating factors, such as psychiatric illness.

2.2.4 Risk Factors Identified in Ecologic Studies

There have been few ecological studies that examine the patterns and contributing factors of parasuicide in Canada, the primary exception being Jarvis et al. (1982), who investigated parasuicide in London, Ontario. However, there have been

several studies examining parasuicide internationally, particularly in the United Kingdom. Internationally, factors investigated with parasuicide can vary from study to study, although there are some factors that are consistently shown to relate to parasuicide. The ecological units of analyses for most ecological studies of parasuicide are sections of cities, such as city electoral wards (Buglass & Duffy, 1978; Congdon, 1996; Kelleher, 1996; Daly et al., 1986) or census tracts (Jarvis et al., 1982).

Unemployment has consistently been associated with parasuicide (Buglass & Duffy, 1978; Jarvis et al., 1982; Congdon, 1996; Kelleher, 1996; Daly et al., 1986; Smith, 1995). The relationship between unemployment and parasuicide can often depend on age and gender. Congdon (1996) found that the rank correlation coefficient between unemployment and parasuicide in males was 0.48 and in females was 0.40. In some cases, researchers controlled for related variables and the correlation between parasuicide and unemployment remain highly statistically significant (Kelleher, et al., 1996).

In addition to unemployment, other variables classified as socioeconomic deprivation that are often studied are overcrowding, ownership of residence, quality of residence, and socioeconomic status. Overcrowding has been shown to be consistently related to parasuicide (Buglass & Duffy, 1978; Daly et al., 1986; Morgan et al., 1975). Ownership of residence has also been implicated, depending on the proportions of privately rented, owner occupied or government-owned residences, as well as the quality of the residence, typically measured in terms of domestic amenities. In most

cases, areas with high privately rented or especially government-owned proportions tend to have higher parasuicide rates (Daly et al., 1986; Congdon, 1996). Lack of domestic amenities has been implicated in higher parasuicide rates (Daly et al., 1986; Morgan et al., 1975). Low socioeconomic status has also been associated with parasuicide (Jarvis et al., 1982).

Jarvis et al. (1982) found that parasuicide rates were highest in the centre of London, Ontario and that the rates decreased outward, with similar findings in Edinburgh, Scotland (Buglass & Duffy, 1978). Social distress calls have also been shown to be related to parasuicide (Kelleher et al., 1996; Buglass & Duffy, 1978). High divorce rates have also been correlated with parasuicide (Morgan et al., 1975), as has population turnover (Congdon, 1996). More recently, Newman and Stuart (2005) compared Edmonton, Alberta and Calgary, Alberta census metropolitan areas (CMA), and found that parasuicide was best predicted by average income, CMA and their interaction term.

As with ecological studies of suicide, many of the above variables are also chosen arbitrarily or based on availability. Congdon (1996) advises that there is strong evidence to suggest that there are differential associations between ecologic variables and parasuicide depending on factors such as age, gender and region.

2.2.5 Methods of Parasuicide

In contrast to suicide, methods used in parasuicide rarely employ violent methods. Kelleher et al. (1996) found that self-poisoning accounted for 92 per cent of

female parasuicides and 70 per cent of male parasuicides. Bland (1998) found that in Edmonton, 75 per cent of all cases were overdoses of medication, with overdoses accounting for 80 per cent of female parasuicides and 66 per cent of male parasuicides. Cutting was the second most frequent method, with 10 and 15 per cent of female and male parasuicides, respectively.

The difference in methods between suicide and parasuicide are not surprising. In suicide firearms and hanging are as frequent as self-poisoning, but since they are so much more lethal, they are rarely present in parasuicide. It is difficult to determine if individuals purposely chose less lethal methods because they did not really wish to die or if they intended to die but chose a less lethal method naively. This is a large impetus for the term 'parasuicide', as intent is hard to determine.

2.2.6 Summary of Parasuicide

Parasuicide is an important risk factor for suicide and is responsible for large numbers of emergency department visits and inpatient stays. Parasuicide rates are high in Alberta compared to the Canadian average and many other provinces, and as such demands attention. As with suicide, the individual-level studies and ecologic studies tend towards the same risk factors, however, ecologic risk factors are often dependent on the demographic characteristics of the population.

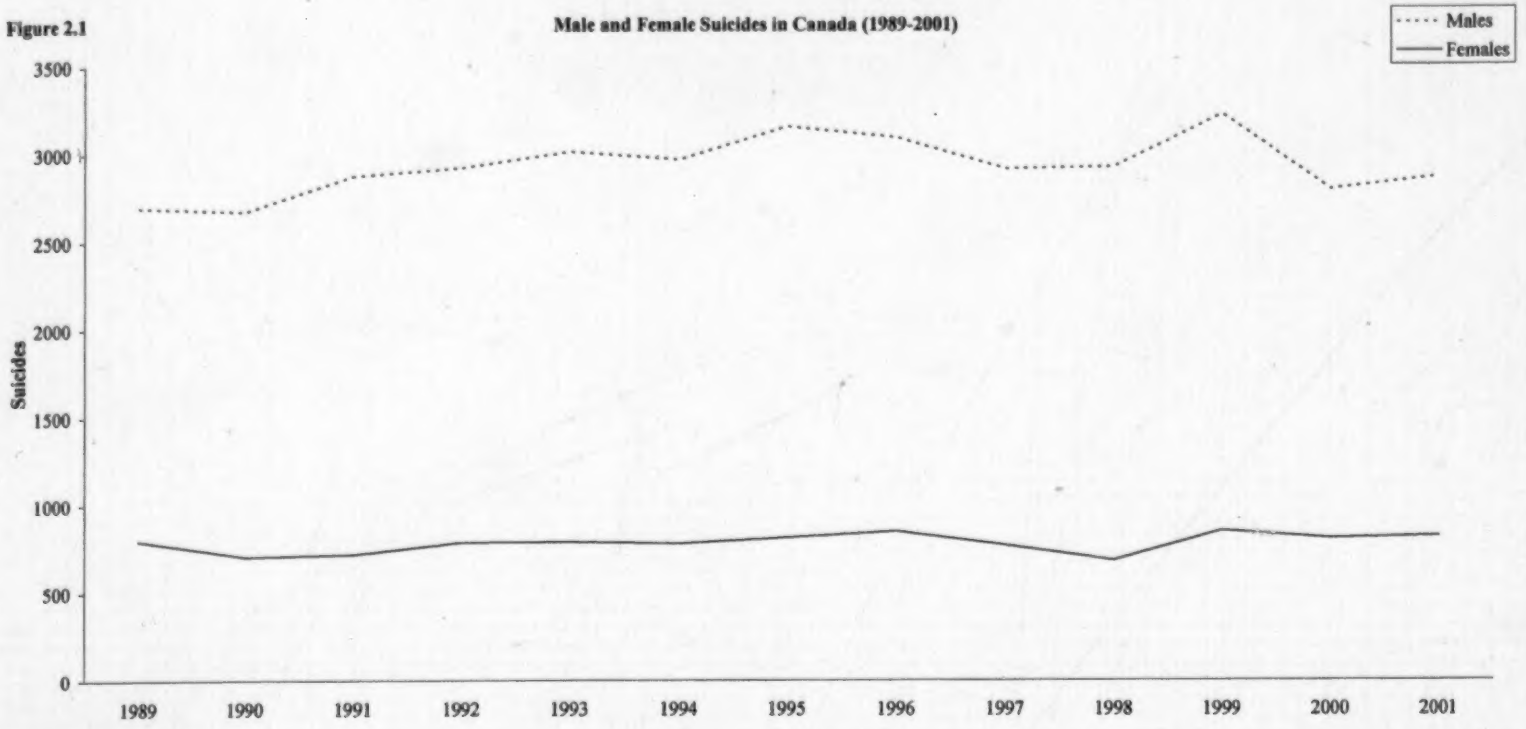
In ecologic studies, factors generated by the aggregation of individual-level characteristics must be considered alongside group-level factors. A common example

of a group-level ecologic factor is the concept of herd immunity in communicable disease. Herd immunity suggests that the probability of being infected with a disease is partially related to the level of immunity in the surrounding population, in addition to individual factors such as age and overall health. The same is likely true for parasuicide. Group-level factors that may be present in a certain region can influence that region's parasuicide rate, as can factors generated by the aggregation of individual-level characteristics. In some cases, ecological variables may be generated that have no counterpart at the individual level, such as herd immunity, or ecological variables may have a counterpart at the individual level, however, each may be related to parasuicide in a different way.

Since there is a shortage of ecological studies of parasuicide in Alberta and it is difficult to apply the results of studies in other regions to Alberta, the aim of the current study is to examine parasuicide in Alberta at the ecological level.

Figure 2.1

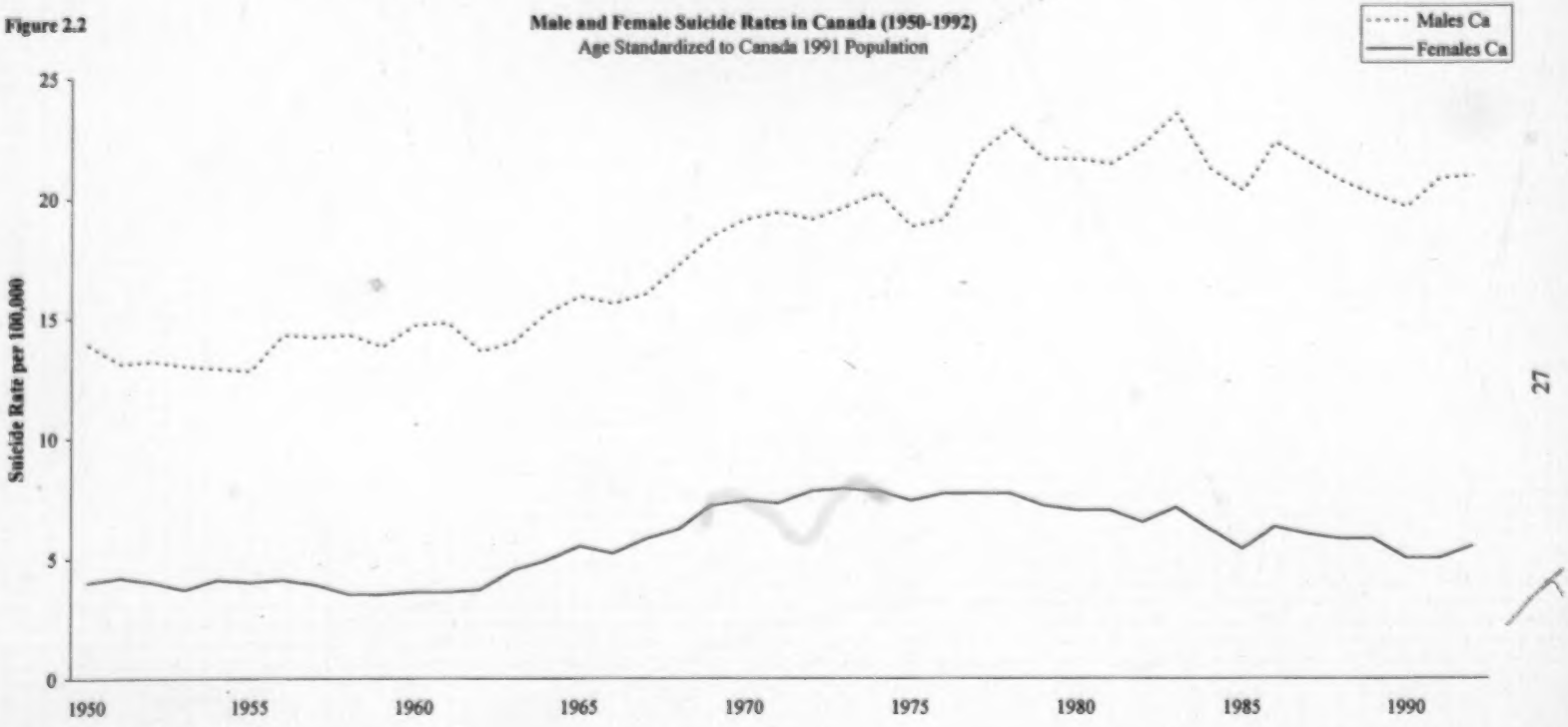
Male and Female Suicides in Canada (1989-2001)



Source: Statistics Canada

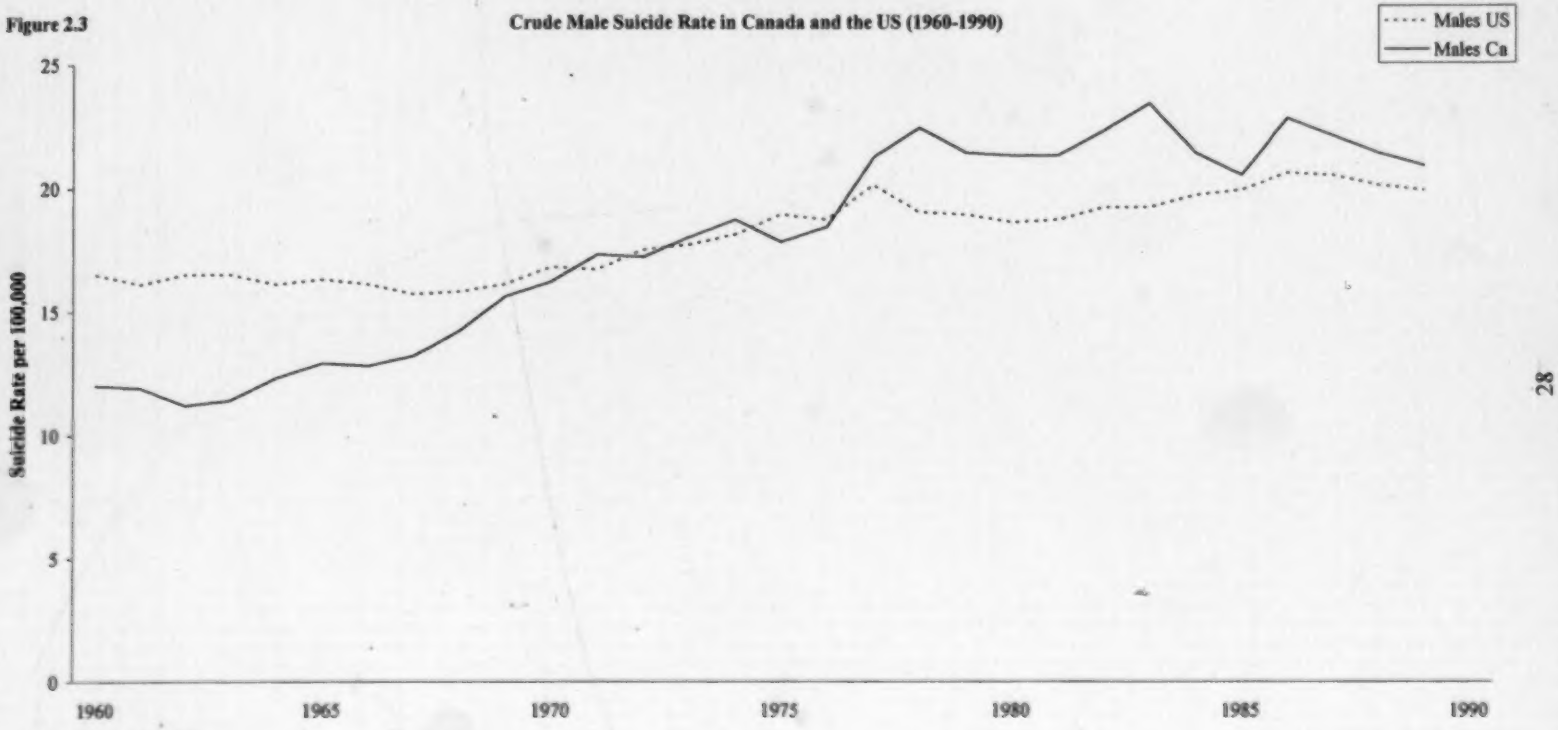
Figure 2.2

Male and Female Suicide Rates in Canada (1950-1992)
Age Standardized to Canada 1991 Population



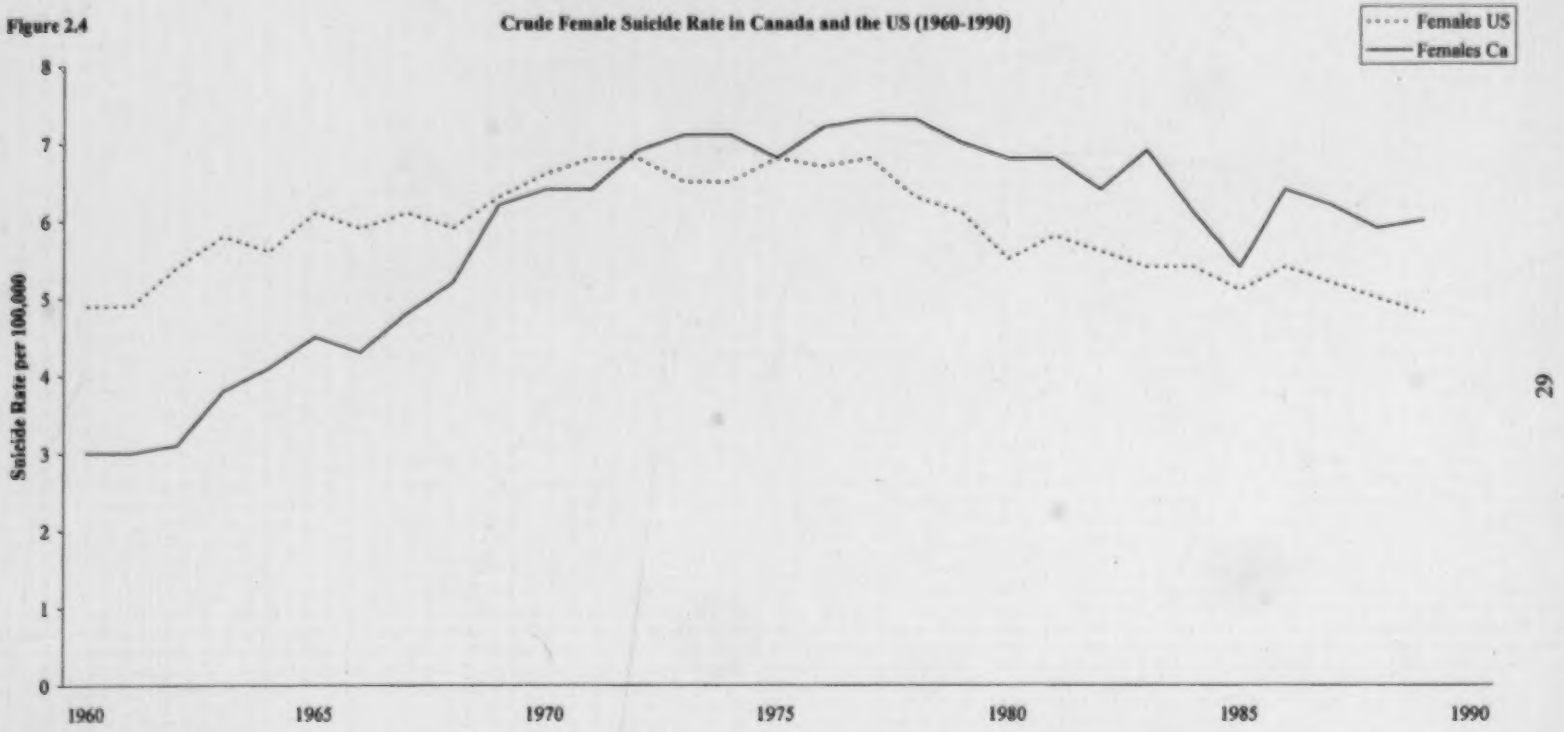
Source: Suicide in Canada (1994)

Figure 2.3 **Crude Male Suicide Rate in Canada and the US (1960-1990)**



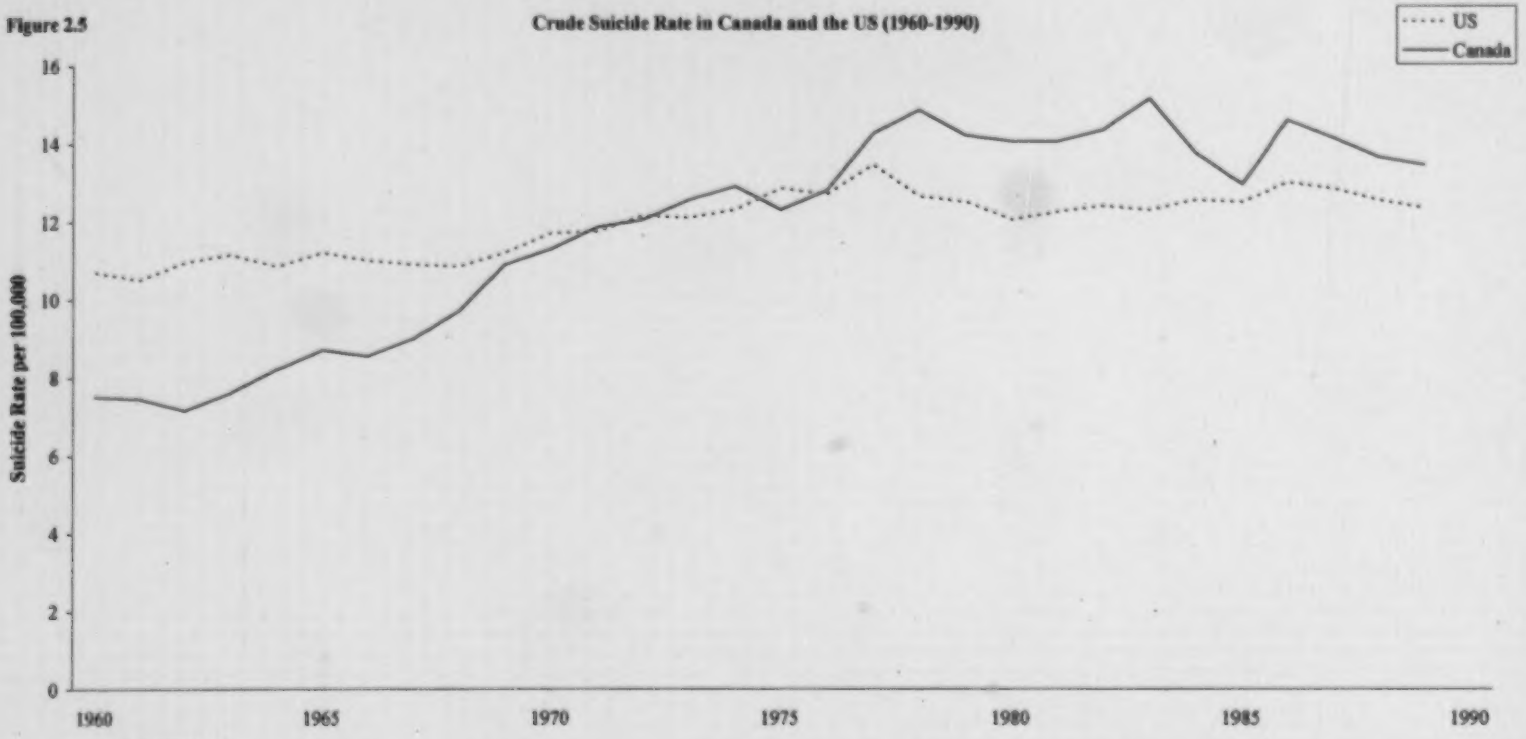
Source: Lester et al (1997)

Figure 2.4 **Crude Female Suicide Rate in Canada and the US (1960-1990)**



Source: Lester et al (1997)

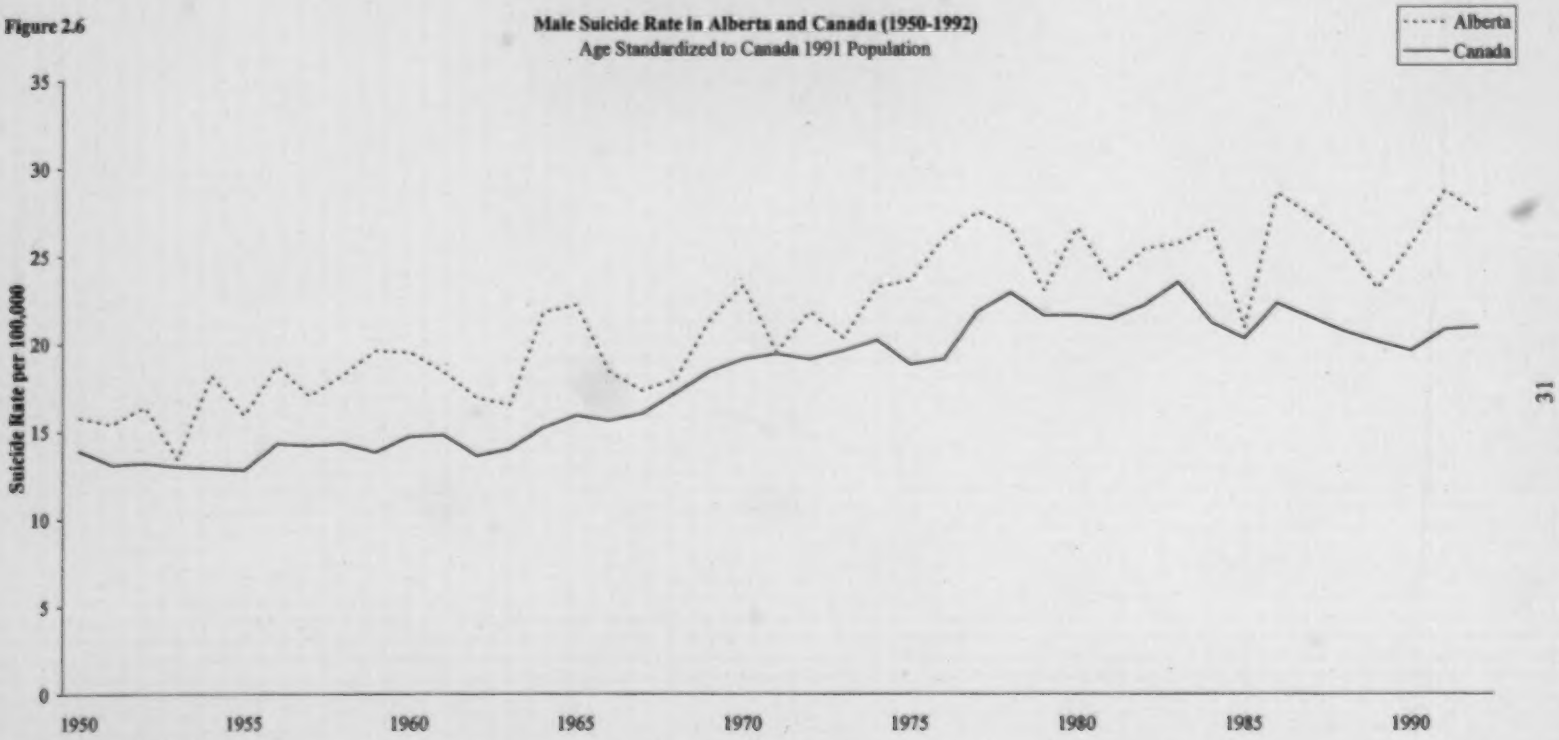
Figure 2.5 **Crude Suicide Rate in Canada and the US (1960-1990)**



Source: Lester et al (1997)

Figure 2.6

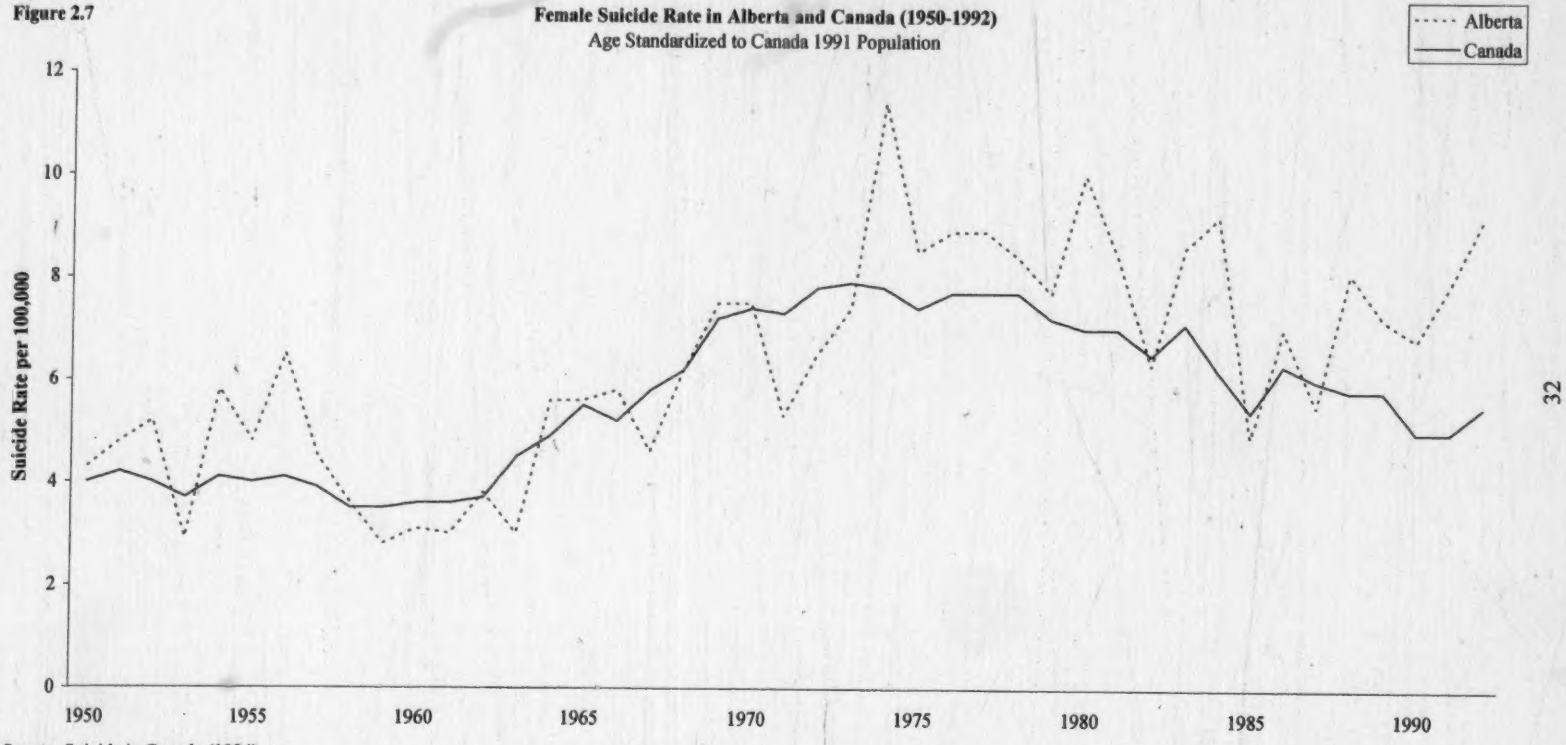
Male Suicide Rate in Alberta and Canada (1950-1992)
Age Standardized to Canada 1991 Population



Source: Suicide in Canada (1994)

Figure 2.7

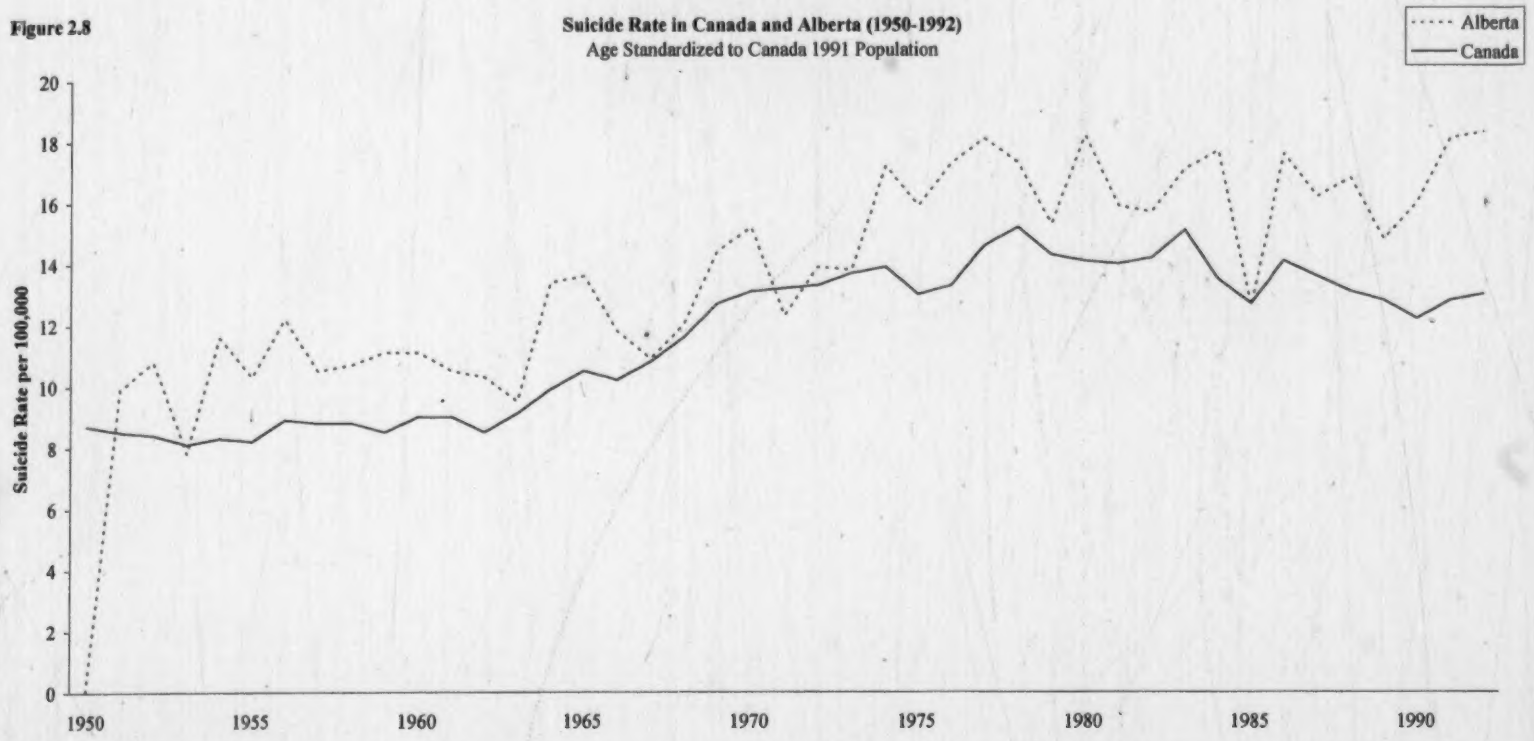
Female Suicide Rate in Alberta and Canada (1950-1992)
Age Standardized to Canada 1991 Population



Source: Suicide in Canada (1994)

Figure 2.8

Suicide Rate in Canada and Alberta (1950-1992)
Age Standardized to Canada 1991 Population



Source: Suicide in Canada (1994)

Figure 2.9

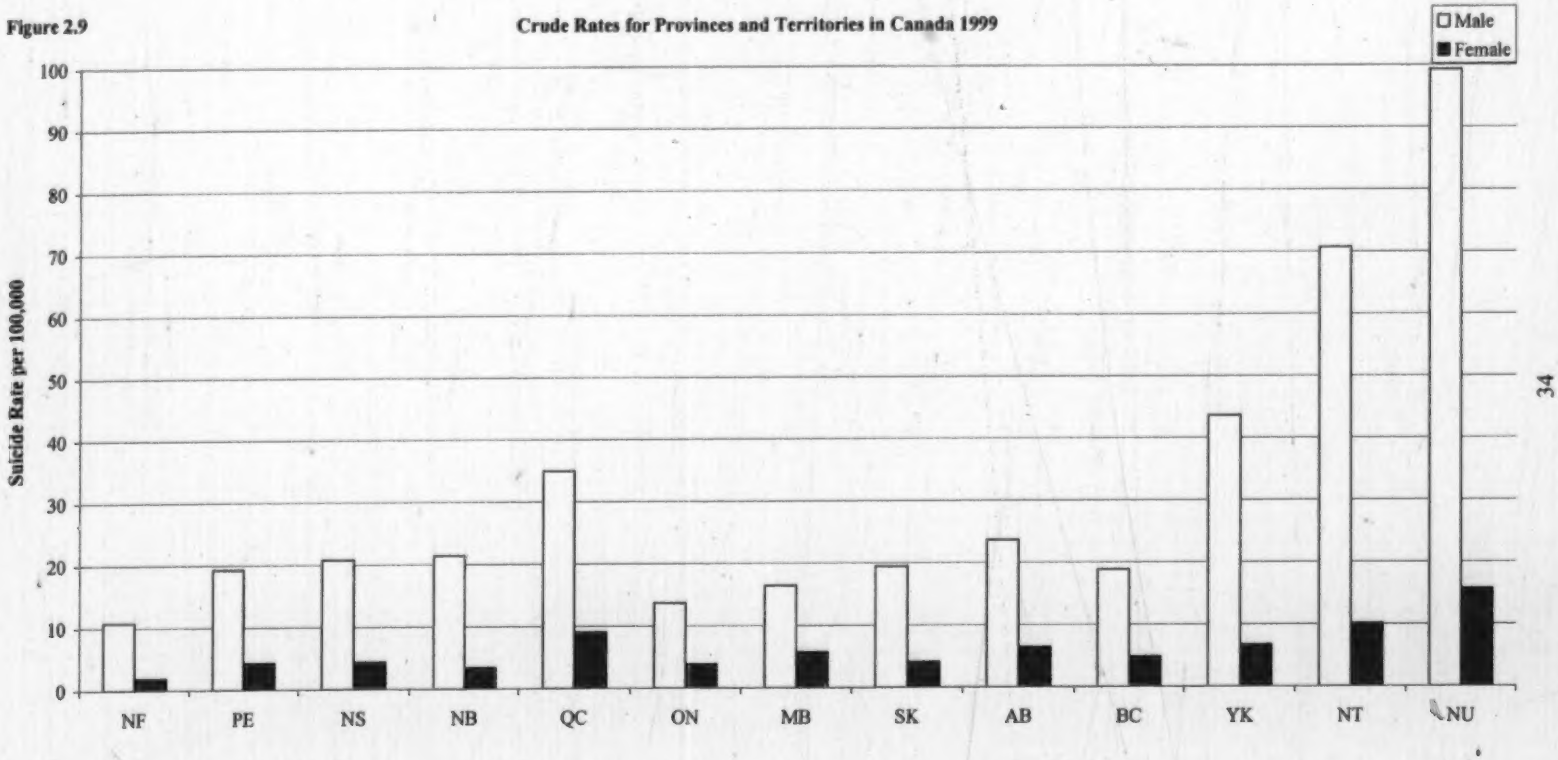
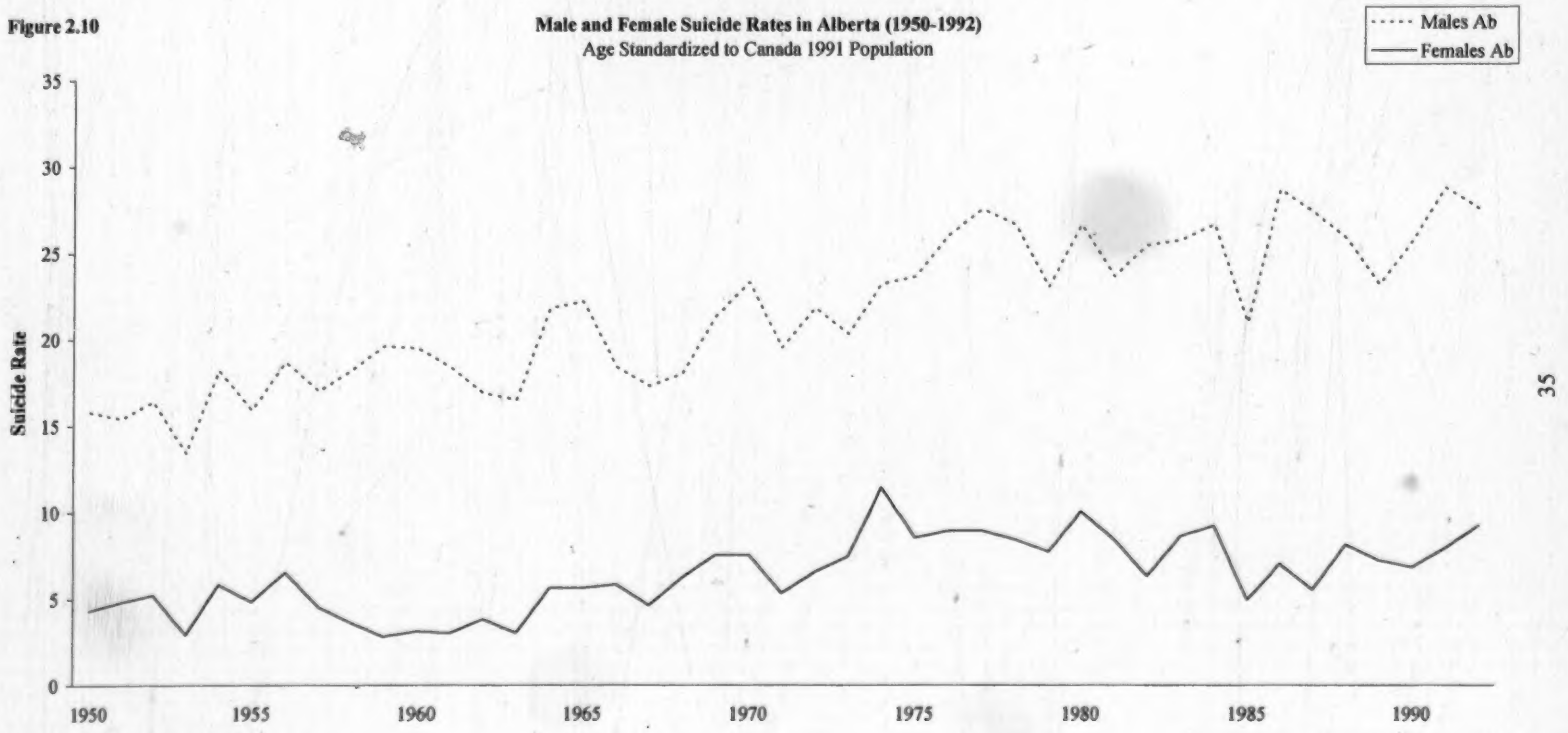

Crude Rates for Provinces and Territories in Canada 1999
Male
Female
Suicide Rate per 100,000
100
90
80
70
60
50
40
30
20
10
0
NF
PE
NS
NB
QC
ON
MB
SK
AB
BC
YK
NT
NU

Figure 2.10

Male and Female Suicide Rates in Alberta (1950-1992)
Age Standardized to Canada 1991 Population



Source: Suicide in Canada (1994)

Chapter 3 – Unit of Analysis and Data Sources

As mentioned above, the current study was undertaken in order to investigate parasuicide in Alberta at the ecologic level. To this end, data for Alberta were assembled from administrative and census databases, and then aggregated to a consistent ecological unit of analysis, the sub-Regional Health Authority (subRHA) (Ellehoj and Schopflocher, 2005).

3.1 Unit of Analysis

Universal health care is provided in Alberta in accordance with the Canada Health Act. Since 1994, health care in Alberta has been provided under the administration of Regional Health Authorities (RHAs), each providing services to residents of a single geographic area. Figure 3.1 shows the current 9 RHA structure.

The number of RHAs is insufficient for ecological analysis, given the number of census variables to be examined. The Public Health Surveillance and Environmental Health Branch of Alberta Health and Wellness has devised smaller, more numerous sub-regions, providing geographic areas more conducive to ecological analyses. Each RHA was divided into smaller sub-regions, dubbed 'subRHAs', and in total, 68 subRHAs were generated (Figure 3.2). For this study, in the administrative data, the subRHA populations in the 15 and older age group ranged from 3405 to 93,887. Only three of the 68 subRHAs had a population in the 15 and older age group of less than 10,000.

3.2 Data Sources

Pre-existing administrative and census data was used for analysis, since collecting province-wide data on parasuicide directly would be prohibitively expensive. The limitations of this strategy are discussed in Chapter 5.

3.2.1 Administrative Data

Emergency department (ED) visit data were assembled from Alberta's Ambulatory Care Classification System (ACCS) for calendar year 1998. ACCS is an administrative database, maintained by Alberta Health and Wellness for the purposes of funding and regional planning. All hospital visits not requiring inpatient admittance, including ED visits, in Alberta are collected and stored using the ACCS system.

Cases of parasuicide were defined based on ED visits with an ICD-9 E-code diagnosis of self-harm (E950-E959). For each individual, only the first of possibly several ED visits in 1998 were retained, in order to calculate the person-based parasuicide incidence rate, an approach taken by Newman & Stuart (2005). Individuals who died in the ED were not excluded as cases. It could be argued that individuals presenting to the ED with self-harm behaviour who die in emergency ought to be considered as cases of suicide. In the current study, however, these individuals – of which there were very few (estimate based on number of suicides and most won't be pronounced dead in emergency room) – were included as parasuicide cases.

ED visit data were initially intended to complement 1996 Statistics Canada census data, however, 1998 is the first year for which ACCS data was collected reliably. The time difference in the ACCS and census data may be viewed as a limitation of the current study, which is discussed in Chapter 5.

3.2.2 Census Data

The second data source was 1996 Statistics Canada census data at the enumeration area level, obtained from Statistics Canada's census website database (www.statcan.ca). All available census variables shown to be related to parasuicide, according to the literature, were selected. Depending on the measure, the census variables were then used to calculate proportions, averages or rates for each subRHA using an enumeration-area-to-subRHA cross-reference file developed by the Public Health Surveillance and Environmental Health Branch of Alberta Health and Wellness (Ellehoj and Schopflocher, 2005).

The enumeration-area-to-subRHA cross-reference file is based on the Alberta Treasury Postal Code Translation file that is created by "examining the address range for each postal code and manually assigning the most appropriate Enumeration Area (EA) to that postal code" (Ellehoj and Schopflocher, 2003). The geographic areas covered by a postal code and its assigned EA do not exactly coincide, which could conceivably lead to miscoding of some parasuicide cases to incorrect sub-RHAs and miscalculation of the census variables per sub-RHA. The miscoding would not likely be systematic, however.

The census variables chosen for the analysis were:

1. Proportion of Aboriginal individuals
2. Proportion of divorced or separated individuals
3. Proportion of individuals living alone
4. Proportion of individuals living in an apartment
5. Proportion of households with 6 or more residents
6. Proportion of individuals with a grade 9 or lower education
7. Proportion of individuals having moved in the previous year
8. Proportion of households renting
9. Proportion of multifamily households
10. Proportion of immigrant individuals
11. Average annual household income
12. Average annual individual income
13. Unemployment rate

'Average annual household income' and 'average annual individual income' were defined as per Statistics Canada census households and individuals, respectively. The unemployment rate was defined as: individuals eligible for employment but not currently employed as a proportion of all individuals eligible for employment. As with the income figures, the unemployment figures were obtained as per Statistics Canada census definitions. The variables generated from the census data are similar to many

of the variables found in other ecological analyses of suicide and parasuicide, such as Jarvis et al. (1982) and Newman & Stuart (2005).

The 'proportion of Aboriginal individuals' variable was included as a predictor variable because of the focus on Aboriginal health in Canada. For example, the First Nations and Inuit Health Branch (FNIHB) of the Government of Canada has a directive to work "with First Nations people and Inuit to improve their health" and note that, "In recent years, First Nations and Inuit health has improved in areas such as living longer and preventing infant deaths. Despite improvements, gaps remain in the overall health status of First Nations and Inuit compared to other Canadians. For example, First Nations people and Inuit have higher rates of injury, suicide and diabetes" (FNIHB website).

The data were analyzed first with descriptive statistics, outlining the magnitudes and relationships between parasuicide and the census variables, followed by preliminary linear regressions in order to get a sense of the direction and relative contribution of the census variables when used in predicting parasuicide. A principal components analysis was then performed on the census variables, generating aggregate scale variables for use in a final linear regression model. A detailed description of the analysis follows in Chapter 4.

Figure 3.1 Regional Health Authorities in Alberta

Figure 3.2 SubRHAs in Alberta

Chapter 4 – Statistical Analysis and Results

4.1 Descriptive Statistics

4.1.1 Parasuicide

The parasuicide rate shown in Table 4.1 is the crude rate for individuals 15 and older. The crude rate is displayed here in order to provide a sense of the magnitude of the parasuicide rate for each region, however, in later analyses the age-sex standardized rate is used. The parasuicide rate varied from a minimum of 0 to a maximum of 839 per 100,000, with an average rate of 236 per 100,000. The subRHA with no parasuicide cases was a northern region with the smallest fifteen-and-older population of all subRHAs (3405). Given that the average parasuicide rate was 236 per 100,000 with a standard deviation of 140, and that 0 per 100,000 is within two standard deviations, it is not statistically surprising that this region had no residents committing parasuicide, as defined in Chapter 3.

Figure 4.1 shows a map of parasuicide rates per subRHA for the entire province of Alberta. Alberta's two largest urban centres, Edmonton and Calgary, are displayed separately in Figures 4.2 and 4.3. Each subRHA is color-coded according to the parasuicide rate standard score for each subRHA. The standard score is calculated (Ellehoj and Schopflocher, 2005) as:

(subRHA Rate – Provincial Rate) / subRHA Standard Error

A standard score of +2 or greater is coded as red, +2 to +1 is coded as orange, +1 to -1 is coded as yellow, -1 to -2 is coded as light green and -2 or less is coded as dark green. At first glance, the parasuicide rates appear to be higher in the north, however, the larger geographic size of these subRHAs creates a slightly misleading image. There were similar numbers of subRHAs with high parasuicide rates in the south of the province and there were also areas with high rates in the urban centres. Taking this into perspective, there does not appear to be an obvious relationship between subRHA geographic location and parasuicide.

Of the two major urban centres in Alberta, the higher parasuicide rate was in Edmonton with 304 per 100,000, compared to Calgary with 201 per 100,000. This is not unexpected as past research has shown that Edmonton has traditionally shown a higher suicide rate (Colman, 2000) and parasuicide rate (Newman & Stuart, 2005).

Table 4.2 summarizes overall age and gender-specific parasuicide rates. Not surprisingly, the highest parasuicide rate by far was among females aged 15-24. Also not surprising is the observation that the next highest parasuicide rate was among males aged 15-24. As expected, the parasuicide rate tended to decrease with age for both genders.

The parasuicide rates in the current study are somewhat lower than those reported by Bland et al. (1994, 1998). Recall that Bland et al. (1994) found that the parasuicide rate for emergency visits at the University of Alberta hospitals, located in

Edmonton, to be 448 per 100,000. Also, Bland et al. (1998) found the overall parasuicide rate in Edmonton to be 376 per 100,000 based on emergency records from all Edmonton hospitals. The overall rate for Edmonton in the current study was 230 per 100,000. This difference could be accounted for by the chart review method used by Bland et al., which may have been able to identify cases that met their definition of parasuicide but that might not have been coded as such into the ACCS system.

Table 4.3 shows how the census variables correlated with the parasuicide rate across the subRHAs. Except for 'proportion with six or more in household', 'proportion with less than grade 9 education' and 'proportion of immigrants', all census variables were statistically significantly correlated with 'parasuicide'. As expected from the literature, 'unemployment' was the most strongly related, while 'average annual household income', 'average annual individual income', 'proportion Aboriginal', 'proportion divorced or separated' and 'proportion of households renting' were also highly correlated – p less than 0.001 – with parasuicide. In addition, the correlations were all in the expected directions. For example, parasuicide was generally higher in areas with higher unemployment and was generally lower in areas with higher average annual household incomes.

Of course, many of the census variables, in addition to being correlated with parasuicide, were correlated with each other. This will be considered in the regression analyses to follow.

Parasuicide rates across subRHAs were not wholly normally distributed as the histogram in Figure 4.4 indicates; the distribution was slightly skewed to the right. The skew is not severe and does not affect the validity of statistical analyses that assume normality (Moore, 1997), therefore, a transformation was not performed in order to preserve interpretability of the parasuicide rate. In fact, the majority of variables were slightly skewed to the right, while only one variable had a distinctly non-normal distribution: proportion of immigrants tended to have a rather uniform distribution, with a few peaks evenly dispersed throughout.

4.1.2 Unemployment

As discussed in Chapter 2, in ecological studies of parasuicide, the unemployment rate was consistently one of the most, if not the most, strongly correlated factors. The current study was no exception. Unemployment correlated highly with parasuicide (0.75, $p < 0.001$) and was more highly correlated with parasuicide than any other single variable, as can be seen in Table 4.3.

As can be seen in Figure 4.5, the overall ecological relationship between parasuicide and unemployment was strongly linear. As expected, the positive relationship indicates that subRHAs with high unemployment rates tended to also have high parasuicide rates. Of note is that in Figure 4.5, the unemployment rate is rounded to two decimal places, resulting in the stacked or staggered appearance of the dots. In the Statistics Canada census data, several of the variables had their counts and populations rounded to the nearest five for confidentiality reasons. For example, if

within a particular enumeration area 14 people were unemployed, the census data would list 15 people as unemployed. Thus, in order to avoid implying a degree of accuracy that the data do not support, variables were rounded to two decimal places.

The relationship between parasuicide and unemployment was similar across groups, broken down by age group and gender. Figures 4.6-4.9 show scatterplots, with regression lines, of the relationship between parasuicide and unemployment broken down by age group and gender. In the 15-24 age group, for both genders, the ecologic relationship between parasuicide and unemployment was less apparent than in the 25 and older age group. Also, within each age group, unemployment and parasuicide were more strongly associated in males.

4.1.3 Income

The two average income measures, individual and household, were very highly correlated with each other (0.94, $p < 0.001$). In addition, both income measures were significantly correlated with parasuicide, as shown in Table 4.3. Figure 4.10 displays an overall scatterplot of parasuicide versus individual income and there appears to be a moderately linear negative relationship. This is not surprising, as based on findings in previous studies (Newman & Stuart, 2005), one would expect subRHAs with higher average individual incomes to have a lower parasuicide rate.

However, examining the relationship further in terms of age and gender, we see that the relationship between average individual income and parasuicide is not as

straightforward as in the overall case. In Figures 4.11 through 4.14, it seems apparent that in the younger age groups, for both genders, the average individual income had little relationship with the parasuicide rate. Only in the older group did the negative relationship seen in the overall case materialize.

4.1.4 Proportion Aboriginal

The proportion of Aboriginal individuals in one subRHA is 0.75. This figure appears to be quite high, given that the overall proportion of Aboriginals in Alberta is approximately 0.05. The raw data were reviewed and the aggregation appears to be accurate. A possible reason that this figure is so high is that this subRHA includes the northernmost area of the province, which includes a number of reserves. Without an urban area to balance the proportion, this figure seems plausible. Furthermore, the Indian and Northern Affairs Canada website notes that northern Saskatchewan – the neighbouring province to the east – has a 0.83 Aboriginal proportion.

4.2 Regression Analysis

Treating the age-sex standardized parasuicide rate per subRHA as the outcome variable and the census variables as the predictor variables, several regression analyses were performed. Rather than performing a regression using the age group-sex standardized parasuicide rate as the outcome variable, performing a weighted regression was also considered (described in 4.2.4). In the end, this method was decided against because a weighted regression lends more influence to subRHAs with larger populations, with the idea that subRHAs with a larger population generate more

reliable estimates. It was decided that there were sufficient subRHA populations that this should not be a concern and all subRHAs were treated as distinct units with equally reliable measures.

In the initial regressions, the predictor variables were input into the models as they were obtained from the Statistics Canada census file. However, as mentioned in 4.1.1, many of the census variables were highly inter-correlated and this may distort the beta coefficients found in the initial regression. A principal components analysis, described fully in 4.2.2, was performed in order to reduce the number of predictor variables by considering their inter-correlations. Factor scores were generated and these scores were then used to develop the final regression model (Lynch, 2003).

4.2.1 Initial Regression Analyses

In order to get a sense of the variables that tend to be important – and the direction of the associations – in predicting the age-sex standardized parasuicide rate, a regression including all census variables was performed (see Table 4.4). The results will be briefly discussed below.

Retaining all census variables, the resulting regression model predicts parasuicide well ($R = 0.84$, $p < 0.001$). Although the contribution of all variables was taken into account, not all variables contributed statistically significantly to the model; only 'proportion Aboriginal', 'proportion of multifamily households', 'average household income', 'average individual income' and 'unemployment rate' were

significant. There were three nearly significant census variables: 'proportion divorced or separated', 'proportion having moved in the past year' and 'proportion of households renting'.

This exploratory initial regression suggests that unemployment is important in terms of predicting parasuicide and that the relationship between unemployment and parasuicide is positive in direction. This confirms the findings of other studies mentioned in Chapter 2. In addition, it appears that the income variables are also important, confirming Newman & Stuart (2005). There also seems to be a strong relationship between parasuicide and more social variables like the 'proportion divorced or separated' and 'proportion having moved in the past year'.

The above initial regression has the benefit of ease of interpretation of the variables and their contributions to the model, but is disadvantaged in that the variables in the model are highly intercorrelated. The high degree of intercorrelation suggests that perhaps seemingly different measures are in essence representing the same underlying construct, thereby making the model overly complex and disguising important underlying relationships.

4.2.2 Principal Components

As a remedy for the high inter-correlations between predictor variables, a principal components analysis was performed to further examine how the census variables relate to each other. A principal components analysis with varimax rotation –

which produces orthogonal or distinct factors – was performed and produced three components. The three components were selected as their eigenvalues were all above one. A principal components analysis with four components was also performed, however, the first three components were largely the same as the three component analysis while the resulting fourth component contained two variables and the loadings were very weak. In addition to the fourth component having an eigenvalue of less than one, having a fourth component tended to reduce the interpretability of the components seen in the three component analysis. Thus, it was decided to proceed with three components.

Table 4.5 shows that the three rotated components were well-defined. Most of the highest loadings for each census variable tended to be greater than 0.70, with the only two somewhat evenly-spread census variables being 'unemployment rate' and 'proportion with a less than grade 9 education'.

4.2.3 Factor Scores

Using the results from the principal components analysis, three factors were chosen (see Table 4.5). Factor 1 contained 'proportion divorced or separated', 'proportion living alone', 'proportion living in an apartment', 'proportion having moved in the previous year', 'proportion of households renting' and 'proportion of immigrants'. It is not difficult to conceptualize this factor as representing transience or weak social integration.

Factor 2 was comprised of 'proportion Aboriginal', 'proportion of households with six or more residents', 'proportion of multifamily households' and 'unemployment rate'. This factor seemed to capture Aboriginal status and household density.

Lastly, factor 3 consisted of 'average annual individual income', 'average annual household income' and the negatively-loading 'proportion with less than grade nine education'. Aside from two outliers with exceptionally high rates of 'less than grade nine education', the relationship between income and 'proportion with less than grade nine education' was strongly linear (see Figures 4.15 and 4.16). The two outliers were both northern subRHAs with small populations and somewhat erratic values for many census variables, as compared with the other subRHAs. Since no other socioeconomic variables are represented by factor 3, it seems that factor 3 largely reflects income and education.

It is necessary to understand how predictor variables are related to each other, however, assigning meaning to factors as above can be rather tenuous and is likely idiosyncratic, and it could be argued that a theme might be found in any combination of census variables contributing to a particular factor. The relationship between the variables may be genuine and the factors may also represent actual constructs, however, it is not a good idea to try to place unfounded confidence in seeming meanings of the factors. For example, if body-mass index (BMI) was added to the principal components analysis above and it loaded highly with Overcrowding, the

apparent meaning of the factor would change drastically. To be prudent, it is important to replicate the relationships to ensure the relationships are genuine and consistent and to assign meaning carefully.

In order to create variables using these factors, three methods were employed to see which predicted parasuicide best. The first used regression method factor scores generated by the statistical software package (Statistical Package for the Social Sciences, version 13.0) during the principal components analysis (regression method variables), the second method summed the z-scores of each of the census variables contributing to a particular component (z-score variables), while the third method simply added the raw values of the contributing census variables (sum variables). Each census variable contributed to a single factor, where the factor had the highest coefficient for a particular variable as described in Table 4.5. Each of the three sets of variables were then used to predict parasuicide and interestingly, all had similar Rs.

Using the factor scores generated by the principal components regression method to predict parasuicide resulted in $R = 0.724$, while the z-score factors resulted in $R = 0.699$ and the raw value summation scores produced $R = 0.722$ (Table 4.6). Although the variables produced using the more complex regression method predicted parasuicide slightly better than the raw value summation method, the magnitude of the improvement was very small.

Factor 1will be referred to as 'Social Transience' in the remaining text, factor 2 will be referred to as 'Overcrowding' and factor 3 will be referred to as 'Income'. These names were chosen as they seem to best reflect the underlying construct represented by each factor.

4.2.4 Final Regression

Because summing the raw values of the contributing census variables was the simplest method of generating factor scores and produced a nearly identical R compared to the variables created using the regression generation method, the sum variables were used in the final regression analysis.

Performing a regression retaining all three sum variables in the model, R was 0.722. Table 4.7 displays the results of the regression. The B coefficient for Income is very small, owing to the magnitude of the factor's values, principally controlled by the summation of the individual and household incomes in dollars. In order to inflate the B coefficient (see Table 4.8), so that it may be more easily observed, Income was divided by 100,000, so that it would appear on the same order of magnitude as the other two factors. Other than the Income B coefficient and the standard error of the coefficient, nothing else in the above results changed as a result of the order of magnitude change. The analysis was rerun and the coefficients may be seen in Table 4.9.

Inflating Income makes it apparent that its B coefficient is negative. Since Income is basically a summation of the two annual income measures, this result is not surprising in light of the scatterplots shown in 4.1.3. The final regression equation is:

Parasuicide Rate $_{\text{age group-sex adj}}$ = 21.21 + 23.79(Social Transience) + 41.82(Overcrowding) – 28.57(Income / 100,000).

For the sake of completeness, as in the initial regressions, both forward and backward regressions were performed using the three sum factors and the results were identical to the above model. In addition, the interaction between the three sum variables was investigated and the interactions did not significantly contribute to the model.

4.2.5 Alternative Regression Approaches

Several more sophisticated regression analyses were performed, producing similar models to the final model discussed above. The final model was selected as it is the most easily interpretable, yet produces similar results to more sophisticated regression models. However, as mentioned previously, there was some skew in the distribution of the age- and sex-standardized parasuicide rate across the subRHAs. A log transformation of the parasuicide rate was performed in an effort to normalize the distribution. The results of the regression are displayed in Table 4.10. The model is similar to the final regression model, except that R is smaller (0.552) and Income is no longer statistically significant. Removing Income from the model and including only

Social Transience and Overcrowding, R is 0.543. It should be noted that the log transformation did not result in a substantially more normal distribution than the non-transformed age- and sex-standardized parasuicide rate. Including further, more complex transformations was not attempted as this would further reduce the interpretability of the model.

A regression model predicting the age- and sex-standardized parasuicide rate was produced using the single highest loading census variable for each factor described in the final regression to represent each factor. This was done to avoid using composite variables, so that the resulting regression equation might have a more straightforward interpretation. For Social Transience, the proportion of households renting loaded most highly (0.953), with Overcrowding represented by the proportion of multifamily households (0.878) and Income represented by average annual household income (0.960). The results are shown in Table 4.11 and the overall form of the model – parasuicide = Social Transience + Overcrowding - Income – is similar to the final regression model, however, R is smaller (0.642).

The crude parasuicide rate was used in a regression model weighted by the inverse of the standard error, assuming a Poisson distribution, that also included the proportion of females and the proportion of individuals aged 15 to 24 as predictor variables, in addition to Social Transience, Overcrowding and Income. Table 4.12 includes the results, showing that this model also has the same overall form as the final model, with a similar R (0.736). Interestingly, the age and sex variables are not

significant in the model, although at the individual level, age and sex have a very clearly defined relationship with parasuicide. This is likely due to the proportion of females and the proportion of individuals aged 15-24 not being sufficiently variable between subRHAs.

Another weighted regression was performed using the age- and sex-adjusted parasuicide rate as the outcome variable. The weighting was done according to the inverse of the standard error, assuming a Poisson distribution, and accounting for the stratified nature of the age- and sex-adjusted parasuicide. The results are shown in Table 4.13. As with the other regression models described above, the overall form was the same and R (0.710) was similar to the final regression model.

4.2.6 Reliability

A reliability analysis was performed on each sum factor to ensure that the factor reliably measures the underlying construct it reflects. For Social Transience, the Chronbach's alpha statistic was 0.87, while for Overcrowding it was 0.56 and for Income it was 0.62. Aside from sum factor 1, the two other sum factors have moderate Chronbach's Alpha statistics. Thus, the factors may be said to reliably measure the underlying construct they represent.

Table 4.1: Descriptive Statistics for the Parasuicide Rate and Census Variables

Characteristic	Mean	SD	Minimum	Maximum
Parasuicide rate per 100,000	229.88	136.77	0.00	839.10
Prop. of Aboriginal individuals	0.06	0.11	0.01	0.75
Prop. of divorced or separated individuals	0.09	0.02	0.02	0.16
Prop. of individuals living alone	0.08	0.05	0.02	0.28
Prop. of individuals living in an apartment	0.11	0.08	0.00	0.34
Prop. of households with 6+ residents	0.05	0.04	0.01	0.28
Prop. of indiv. with a grade 9 or lower educ.	0.09	0.06	0.02	0.44
Prop. of indiv. moved in previous year	0.18	0.05	0.11	0.32
Prop. of households renting	0.28	0.12	0.06	0.71
Prop. of multifamily households	0.01	0.01	0.00	0.06
Prop. of immigrant individuals	0.12	0.08	0.03	0.30
Average annual household income ($)	50,076	9272	29,749	74,434
Average annual individual income ($)	25,307	4282	15,989	36,903
Unemployment rate	0.07	0.02	0.03	0.15

Table 4.2: Parasuicide According to Age Group and Gender, Alberta, 1998

	Age Group			
	15-24	25-34	35+	15+
			Male	
Cases	688	638	975	2301
Population	110,644	321,063	701,318	1,133,025
Rate (per 100,000)	621.8	198.7	139.0	203.1
			Female	
Cases	1099	694	1304	3097
Population	105,495	320,617	726,525	1,152,637
Rate (per 100,000)	1041.8	216.5	179.5	268.69
			Both	
Cases	1787	1332	2279	5398
Population	216,139	641,680	1,427,843	2,285,662
Rate (per 100,000)	826.8	207.6	159.6	236.2

Table 4.3: Correlation Between Parasuicide and Census Variables

Census Variable	Correlation	Significance
Prop. of Aboriginal individuals*	0.53	<0.001
Prop. of divorced or separated individuals*	0.46	<0.001
Prop. of individuals living alone*	0.29	0.017
Prop. of individuals living in an apartment*	0.29	0.015
Prop. of households with 6+ residents	0.11	0.395
Prop. of indiv. with a gr.9 or lower educ.	0.20	0.102
Prop. of indiv. moved in previous year*	0.35	0.004
Prop. of households renting*	0.44	<0.001
Prop. of multifamily households*	0.31	0.009
Prop. of immigrant individuals	0.20	0.094
Average annual household income*	-0.41	<0.001
Average annual individual income*	-0.39	0.001
Unemployment rate*	0.75	<0.001

* Statistically Significant ($p < 0.05$)

Table 4.4: Initial Linear Regression Results

Model Summary		
R	R^2	Std Error of Estimate
0.840	0.705	9.55

Predictors: Constant, All Census Variables

ANOVA					
Model	Sum Squares	df	Mean Square	F	Significance
Regression	11758.58	13	904.51	9.92	<0.001
Residual	4924.41	54	91.19		
Total	16682.99	67			

Predictors: Constant, All Census Variables

Dependent Variable: Parasuicide Rate, Age Group- and Sex-standardized

Table 4.4: Initial Linear Regression Results, Continued

Model	Coefficients		
	B	Standard Error B	Significance
Constant	-6.77	18.65	0.718
Prop. Aboriginal	52.01	23.65	0.032
Divorced/Separated	277.21	143.73	0.059
Living Alone	61.61	80.69	0.448
Living Apartment	-17.31	35.84	0.631
Six Plus Household	2.76	73.44	0.970
Less Than Gr. 9	11.48	52.57	0.828
Moved Past Year	-111.18	73.50	0.136
Rent Household	88.42	48.18	0.072
Multifam. Household	-636.76	215.87	0.005
Immigration	1.97	37.52	0.958
Avg. Inc. Household	0.003	0.001	0.030
Avg. Inc. Individual	-0.006	0.002	0.013
Unemployment	260.52	0.00	0.023

Table 4.5: Census Variables Rotated Component Matrix

	Component 1	Component 2	Component 3
Prop. of Aboriginal individuals	-0.053	**0.770**	-0.280
Prop. of divorced or separated individuals	**0.918**	-0.020	0.015
Prop. of individuals living alone	**0.779**	-0.330	-0.329
Prop. of individuals living in an apartment	**0.908**	-0.128	0.072
Prop. of households with 6+ residents	-0.444	**0.711**	-0.278
Prop. of indiv. with a gr.9 or lower educ.	-0.281	0.489	**-0.661**
Prop. of indiv. moved in previous year	**0.826**	0.111	0.126
Prop. of households renting	**0.953**	-0.038	-0.091
Prop. of multifamily households	0.098	**0.878**	0.078
Prop. of immigrant individuals	**0.660**	0.156	0.300
Average annual household income	-0.146	-0.049	**0.960**
Average annual individual income	0.087	-0.229	**0.892**
Unemployment rate	0.518	**0.654**	-0.280

Table 4.6: Factor Variables in Primary Linear Regression Results

	R	R S.E.	B	B S.E.	p
Regression					
Variables	0.724	11.13			
Constant			28.17	1.35	<0.001
Social Transience			8.70	1.36	<0.001
Overcrowding			5.27	1.36	<0.001
Income			-5.22	1.36	<0.001
Z-Score Variables	0.699	11.55			
Constant			28.17	1.40	<0.001
Social Transience			1.63	0.28	<0.001
Overcrowding			1.77	0.51	0.001
Income			-1.27	0.61	0.040
Sum Variables	0.722	11.16			
Constant			21.21	9.91	0.036
Social Transience			23.79	3.93	<0.001
Overcrowding			41.82	9.42	<0.001
Income			0.0002857	0.00011	0.010

Table 4.7: Sum Factor Variables in Linear Regression Results

Model Summary		
R	R^2	Std Error of Estimate
0.722	0.52	11.16

Predictors: Constant, Social Transience, Overcrowding, Income

ANOVA					
Model	Sum Squares	df	Mean Square	F	Significance
Regression	8708.28	3	2902.76	23.30	<0.001
Residual	7974.70	64	124.61		
Total	16682.99	67			

Predictors: Constant, Social Transience, Overcrowding, Income

Dependent Variable: Parasuicide Rate, Age Group- and Sex-standardized

Table 4.8: Sum Factor Variables in Linear Regression Coefficients

	Coefficients		
Model	B	Standard Error B	Significance
Constant	21.21	9.91	0.036
Social Transience	23.79	3.93	<0.001
Overcrowding	41.82	9.42	<0.001
Income	0.00	0.00	0.010

Table 4.9: Sum Factor Regression Coefficients – Income Inflated

	Coefficients		
Model	B	Standard Error B	Significance
Constant	21.21	9.91	0.036
Social Transience	23.79	3.93	<0.001
Overcrowding	41.82	9.42	<0.001
Income	-28.57	10.80	0.010

Table 4.10: Sum Factor Variables in Linear Regression Results, Natural Logarithm Transformation of the Age Group- and Sex-standardized Parasuicide Rate

Model Summary		
R	R^2	Std Error of Estimate
0.552	0.31	0.55

Predictors: Constant, Social Transience, Overcrowding, Income Inflated

ANOVA					
Model	Sum Squares	df	Mean Square	F	Significance
Regression	8.36	3	2.79	9.35	<0.001
Residual	19.07	64	0.30		
Total	27.42	67			

Predictors: Constant, Social Transience, Overcrowding, Income Inflated

Dependent Variable: Natural Logarithm of the Age Group- and Sex-standardized Parasuicide Rate

Table 4.10: Sum Factor Variables in Linear Regression Results, Natural Logarithm Transformation of the Age Group- and Sex-standardized Parasuicide Rate, Continued

	Coefficients		
Model	B	Standard Error B	Significance
Constant	2.60	0.49	<0.001
Social Transience	0.88	0.19	<0.001
Overcrowding	1.12	0.46	<0.018
Income	-0.51	0.53	0.335

Table 4.11: Proportion of Households Renting, Proportion of Multi-family Households and Average Household Income in Linear Regression Results, Age Group- and Sex-standardized Parasuicide Rate

Model Summary		
R	R^2	Std Error of Estimate
0.642	0.41	12.38

Predictors: Constant, Proportion of Households Renting, Proportion of Multi-family Households, Average Household Income Inflated

ANOVA

Model	Sum Squares	df	Mean Square	F	Significance
Regression	6873.02	3	2291.01	14.95	<0.001
Residual	9809.97	64	153.28		
Total	16682.99	67			

Predictors: Constant, Proportion of Households Renting, Proportion of Multi-family Households, Average Household Income Inflated

Dependent Variable: Age Group- and Sex-standardized Parasuicide Rate

Table 4.11: Proportion of Households Renting, Proportion of Multi-family Households and Average Household Income in Linear Regression Results, Age Group- and Sex-standardized Parasuicide Rate, Continued

	Coefficients		
Model	B	Standard Error B	Significance
Constant	33.92	9.96	0.001
H-holds Renting	58.35	12.37	<0.001
Multifam H-holds	309.81	140.71	0.031
Avg. H-hold Income	-50.28	16.69	0.004

Table 4.12: Sum Factor Variables, Proportion Female and Proportion Aged 15 to 24 in Weighted Linear Regression Results, Crude Parasuicide Rate

Model Summary

R	R^2	Std Error of Estimate
0.736	0.54	5.03

Predictors: Constant, Social Transience, Overcrowding, Income Inflated, Proportion Female, Proportion Aged 15 to 24

ANOVA

Model	Sum Squares	df	Mean Square	F	Significance
Regression	1819.78	5	363.96	14.41	<0.001
Residual	1540.79	61	25.26		
Total	3360.56	66			

Predictors: Constant, Social Transience, Overcrowding, Income Inflated, Proportion Female, Proportion Aged 15 to 24

Dependent Variable: Crude Parasuicide Rate,

Weighted by: The Inverse Standard Error, Assuming a Poisson Distribution

Table 4.12: Sum Factor Variables, Proportion Female and Proportion Aged 15 to 24 in Weighted Linear Regression Results, Crude Parasuicide Rate, Continued

	Coefficients		
Model	B	Standard Error B	Significance
Constant	7.04	43.36	0.872
Social Transience	17.86	5.28	0.001
Overcrowding	52.07	12.69	<0.001
Income	-17.28	7.54	0.025
Proportion Female	-13.53	83.79	0.872
Proportion 15 to 24	49.05	47.82	0.309

Table 4.13: Sum Factor Variables in Weighted Linear Regression Results, Age Group- and Sex-standardized Parasuicide Rate

Model Summary		
R	R^2	Std Error of Estimate
0.710	0.50	5.35

Predictors: Constant, Social Transience, Overcrowding, Income Inflated

ANOVA					
Model	Sum Squares	df	Mean Square	F	Significance
Regression	1829.17	3	609.73	21.29	<0.001
Residual	1804.19	63	28.64		
Total	3633.36	66			

Predictors: Constant, Social Transience, Overcrowding, Income Inflated

Dependent Variable: Age Group- and Sex-standardized Parasuicide Rate

Weighted by: The Inverse Standard Error, Assuming a Poisson Distribution, Accounting for Stratification of Age Group- and Sex-standardized Parasuicide Rate

Table 4.13: Sum Factor Variables in Weighted Linear Regression Results, Age Group- and Sex-standardized Parasuicide Rate, Continued

	Coefficients		
Model	B	Standard Error B	Significance
Constant	13.63	9.13	0.140
Social Transience	20.02	3.76	<0.001
Overcrowding	55.57	12.17	<0.001
Income	-18.76	9.22	0.046

Figure 4.1 Parasuicide Rate per SubRHA

Red:	2+ Standard Scores
Orange:	1 to 2 Standard Scores
Yellow:	Average
Green:	-1 to -2 Standard Scores
Dark Green:	-2+ Standard Scores

Figure 4.2 Parasuicide Rate per Edmonton RHAs

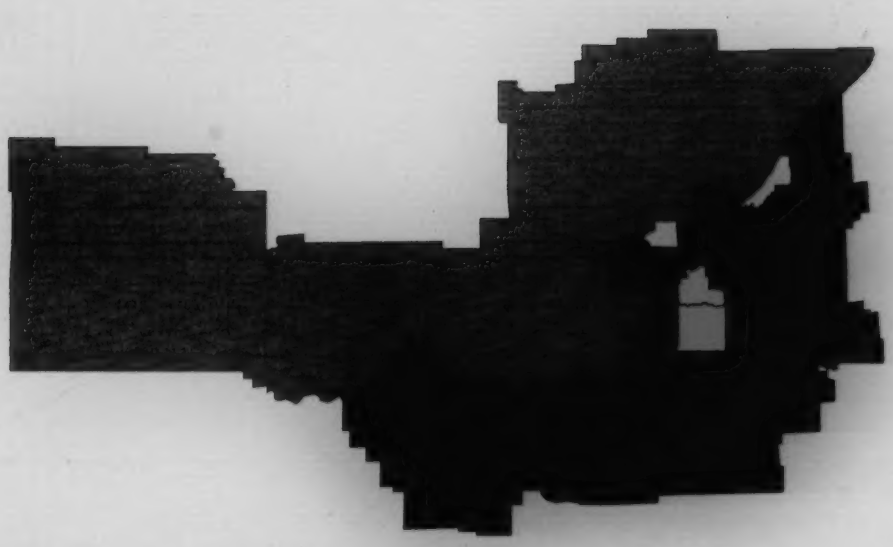


Figure 4.3 Parasuicide Rate per Calgary RHAs

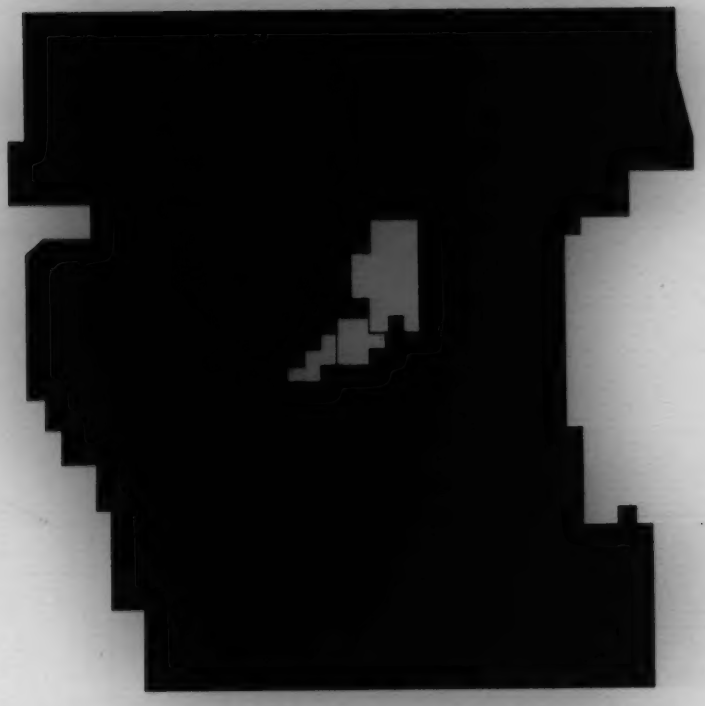


Figure 4.4

Frequency Distribution of Parasuicide Rates in SubRHAs

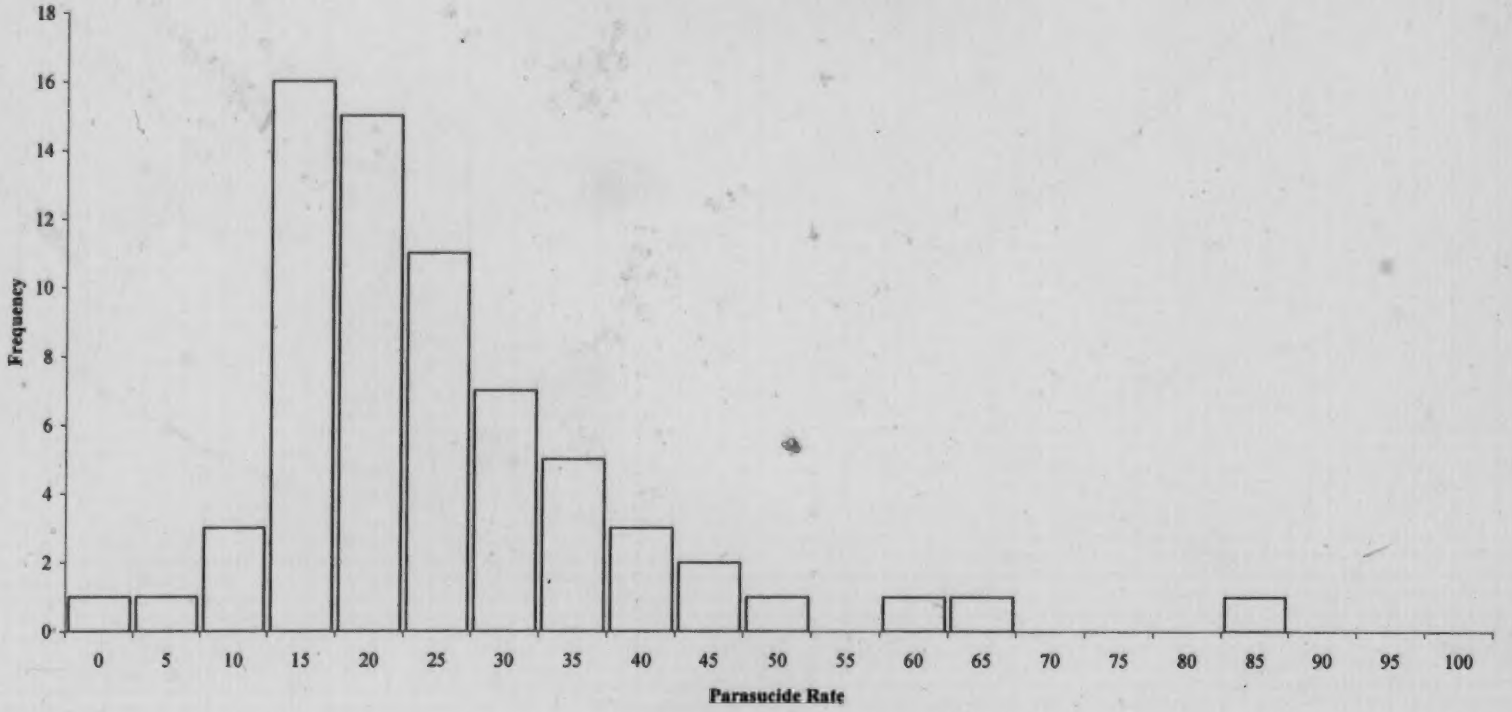


Figure 4.5

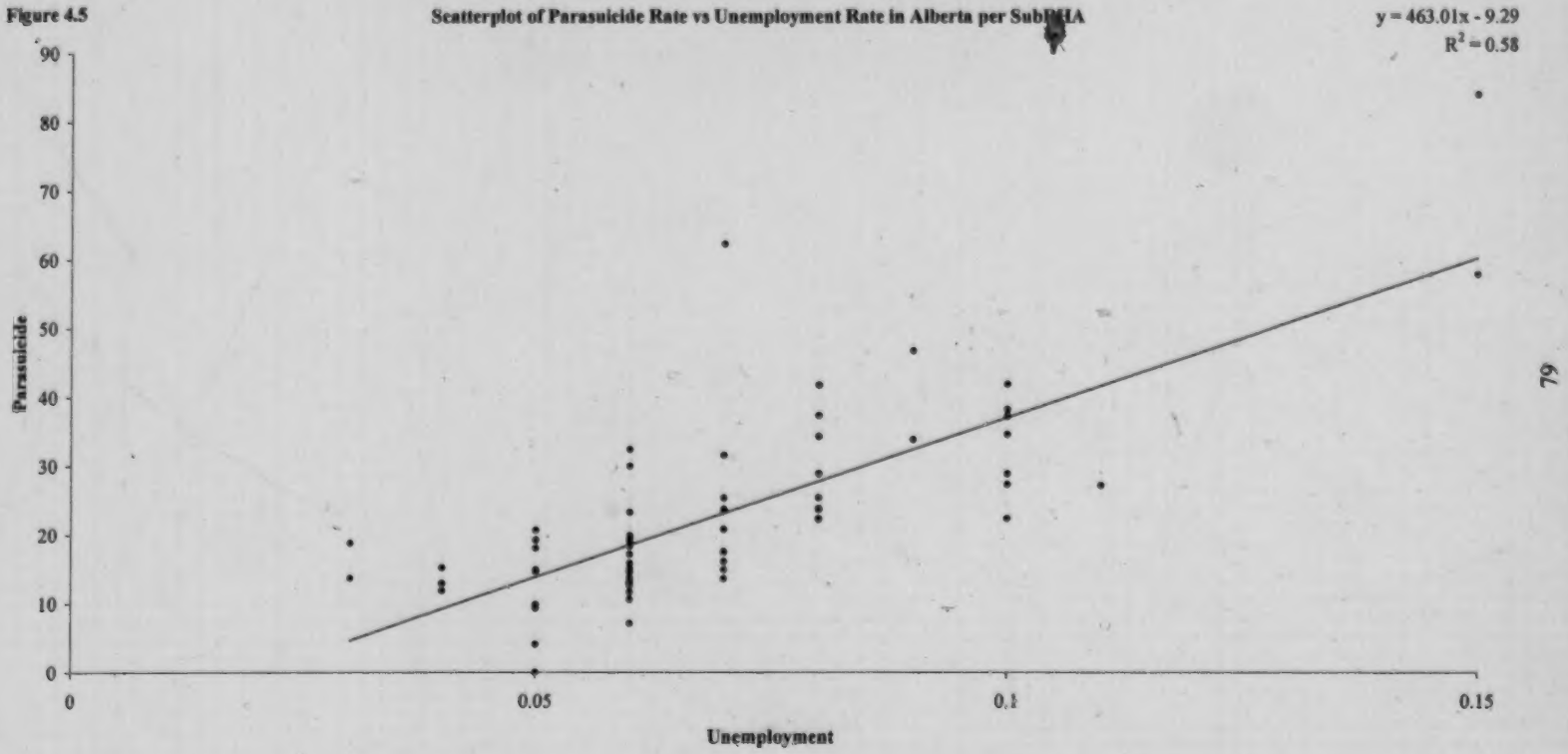

Scatterplot of Parasuicide Rate vs Unemployment Rate in Alberta per SubRHA
y = 463.01x - 9.29
R² = 0.58
Parasuicide
Unemployment
0
10
20
30
40
50
60
70
80
90
0
0.05
0.1
0.15

Figure 4.6 **Scatterplot of Parasuicide Rate vs Unemployment Rate in Alberta Males Ages 15-24 Years per SubRHA**

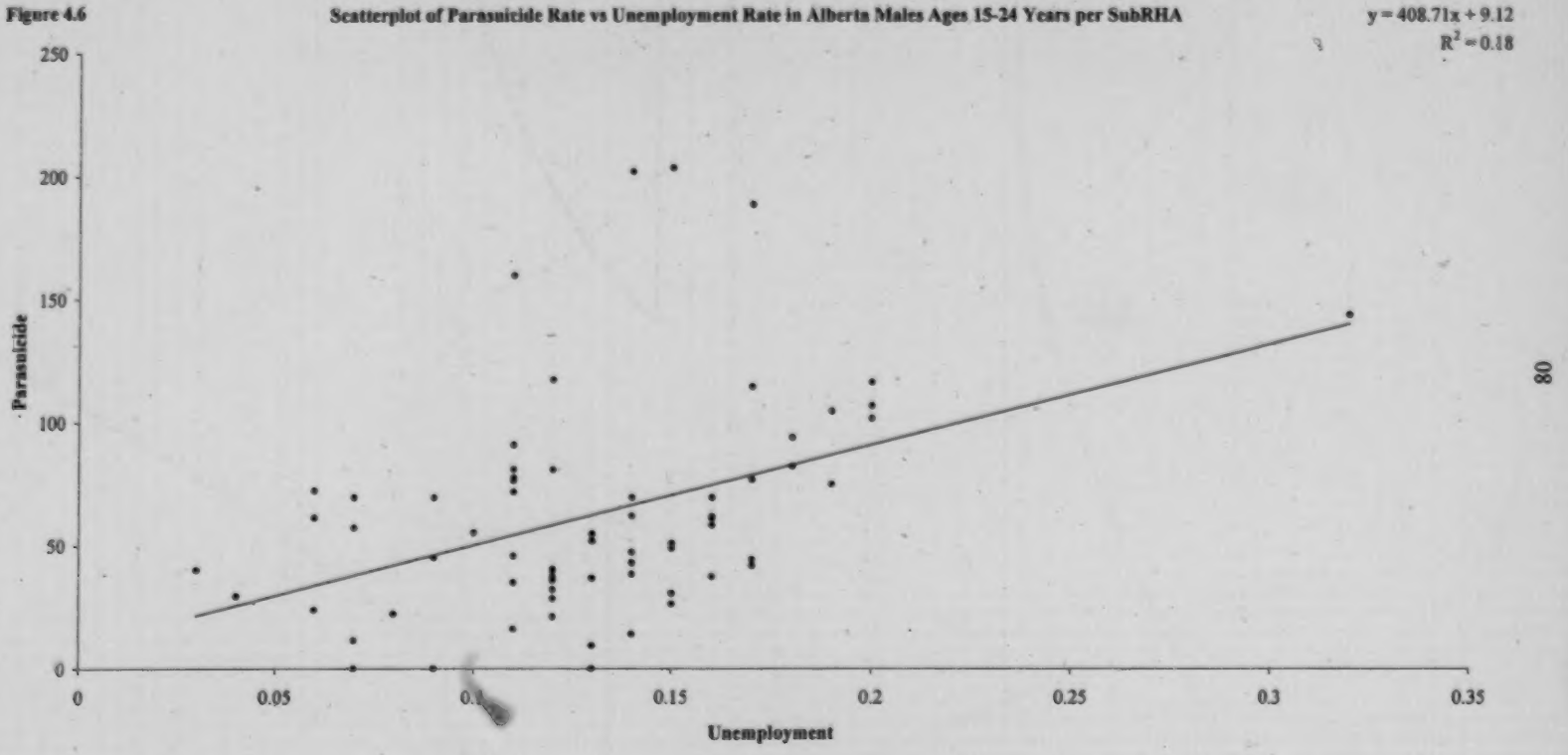


Figure 4.7 Scatterplot of Parasuicide Rate vs Unemployment Rate in Alberta Females Ages 15-24 Years per SubRHA

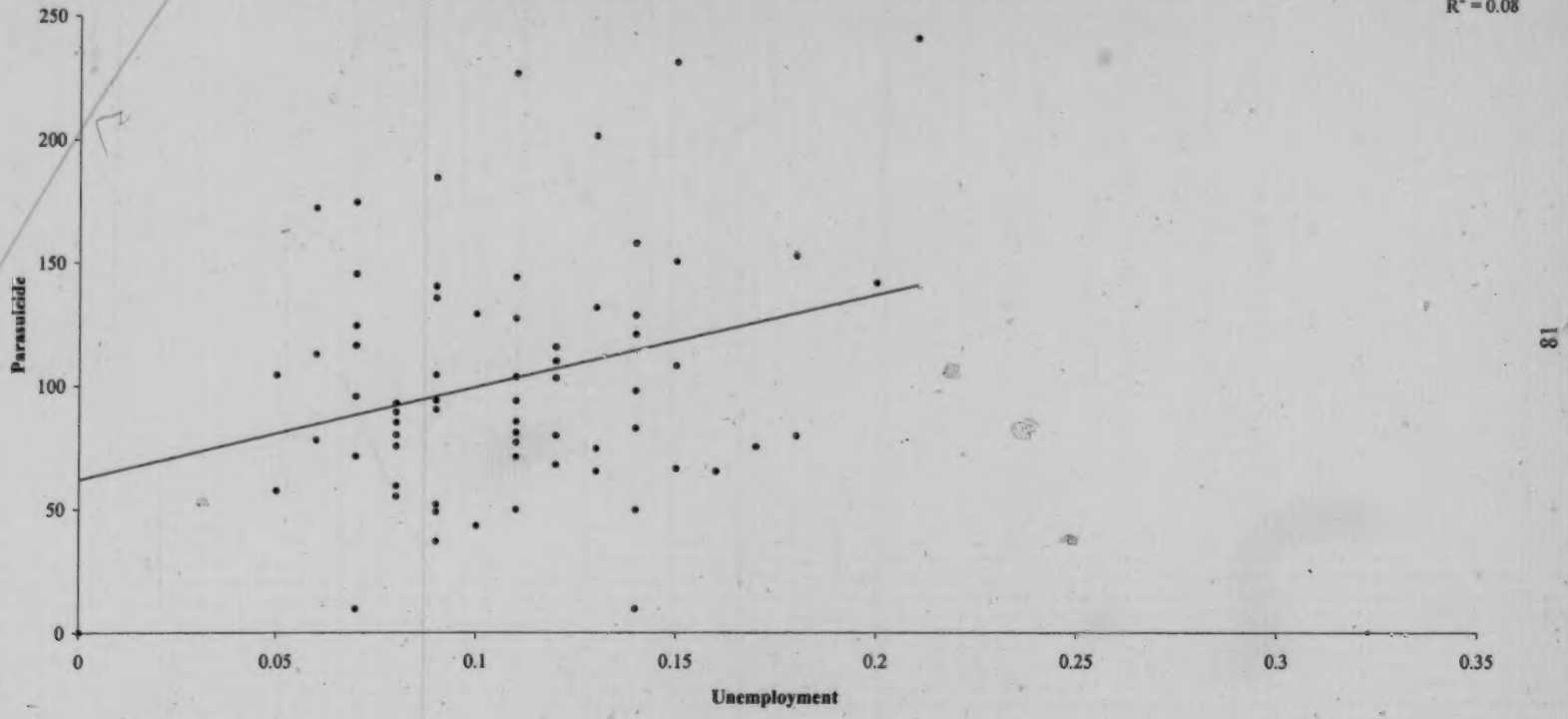


Figure 4.8 **Scatterplot of Parasuicide Rate vs Unemployment Rate in Alberta Males Ages 25 Years and Older per SubRHA**

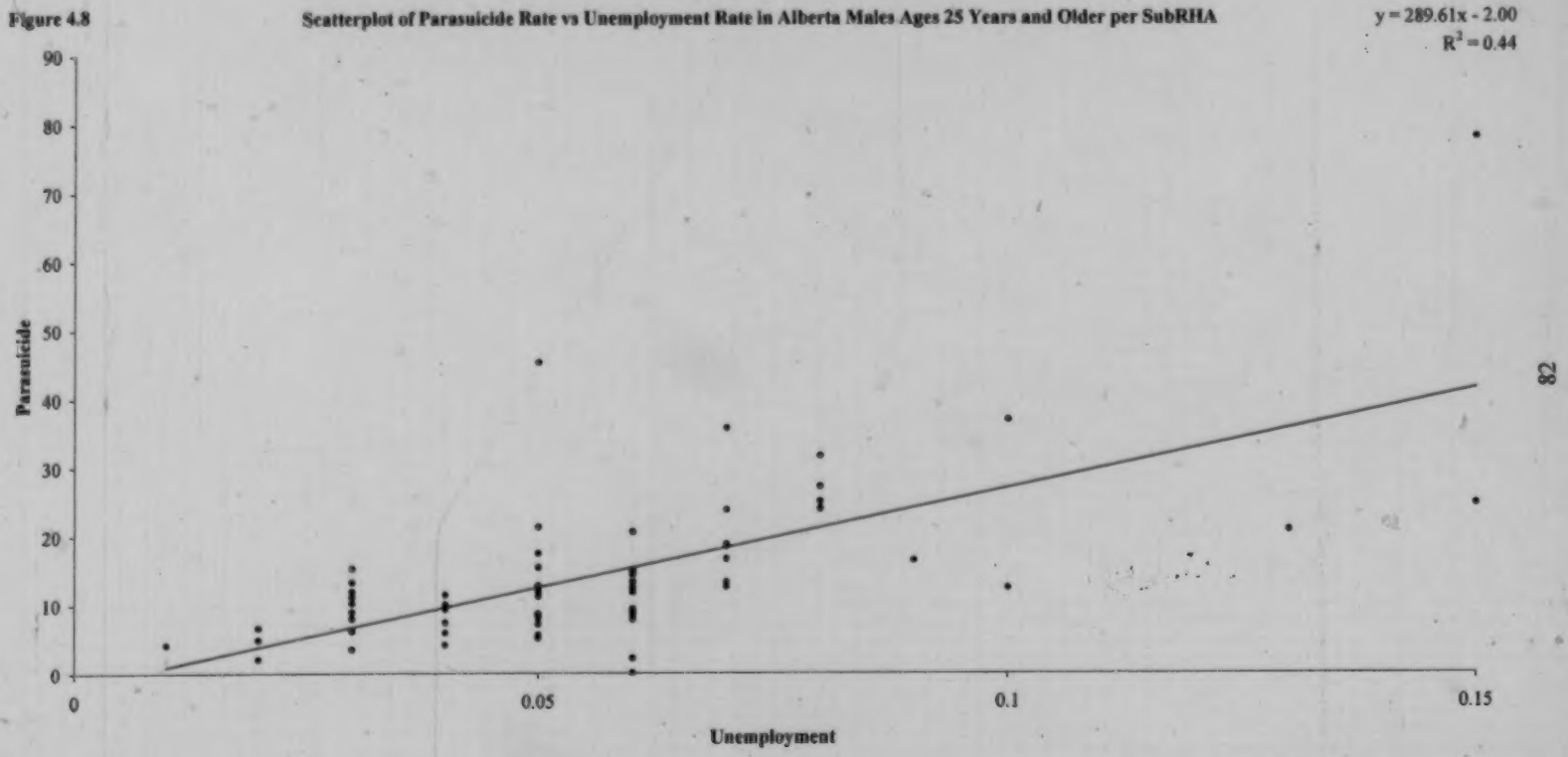


Figure 4.9 Scatterplot of Parasuicide Rate vs Unemployment Rate in Alberta Females Ages 25 and Older per SubRHA

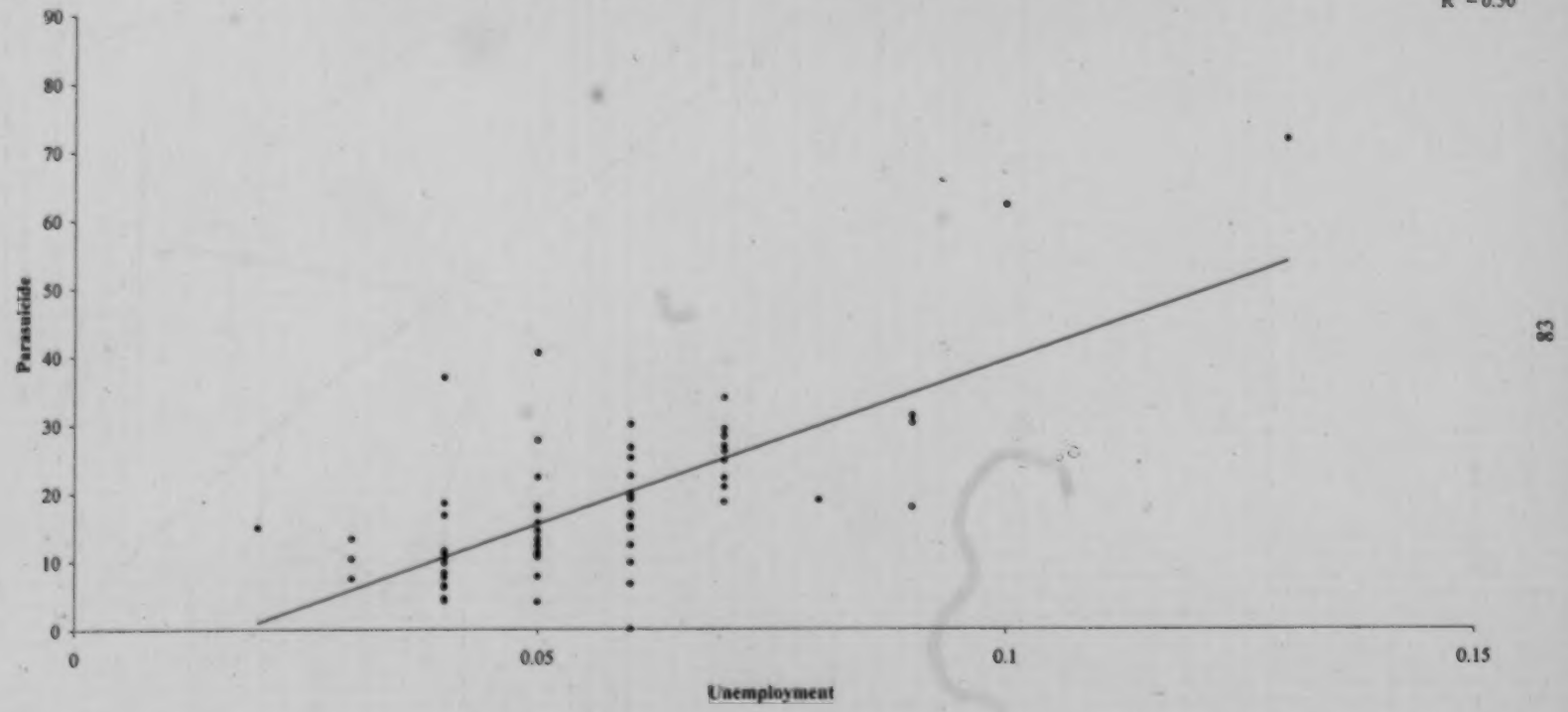


Figure 4.10 **Scatterplot of Parasuicide Rate vs Average Individual Income in Alberta per SubRHA**

$y = -0.00x + 54.66$
$R^2 = 0.15$

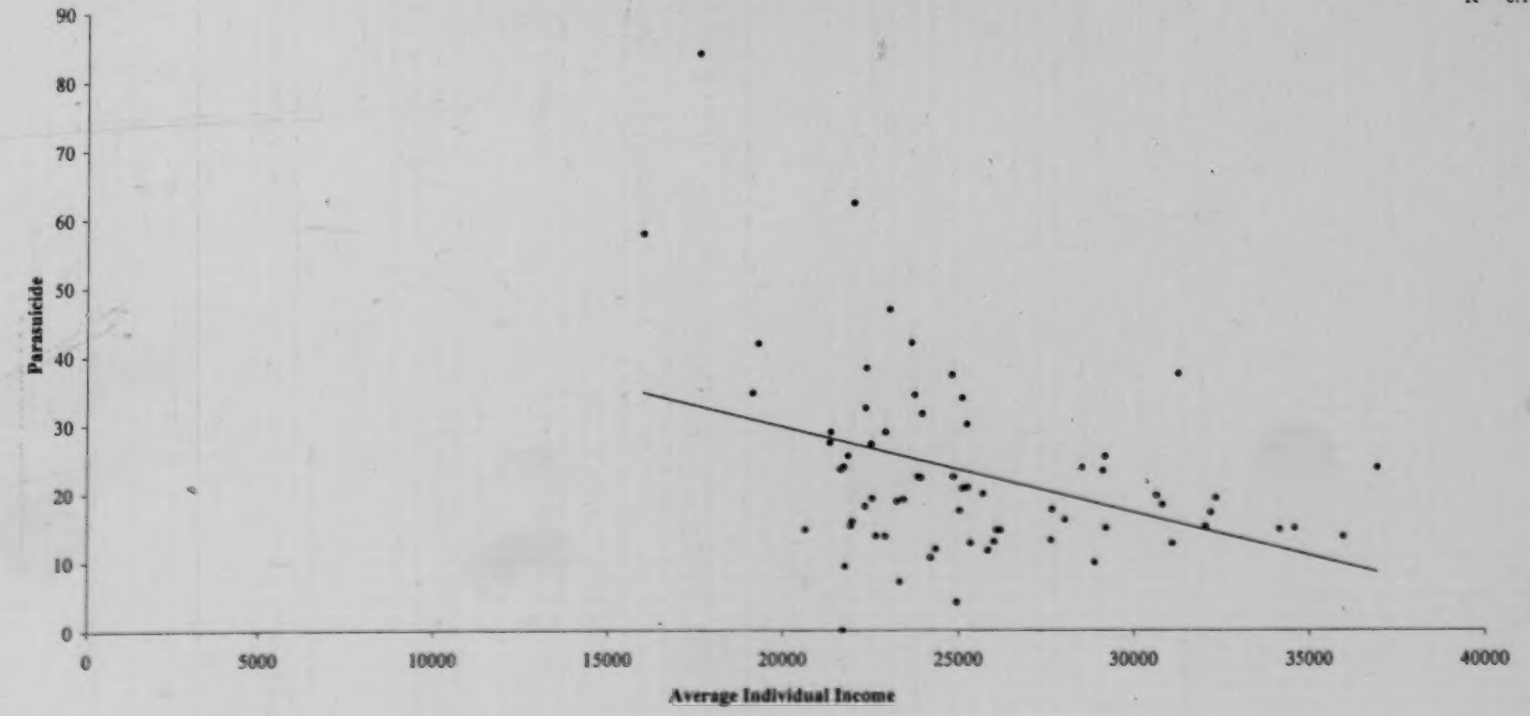


Figure 4.11 Scatterplot of Parasuicide Rate vs Average Individual Income in Alberta Males Ages 15-24 Years per SubRHA

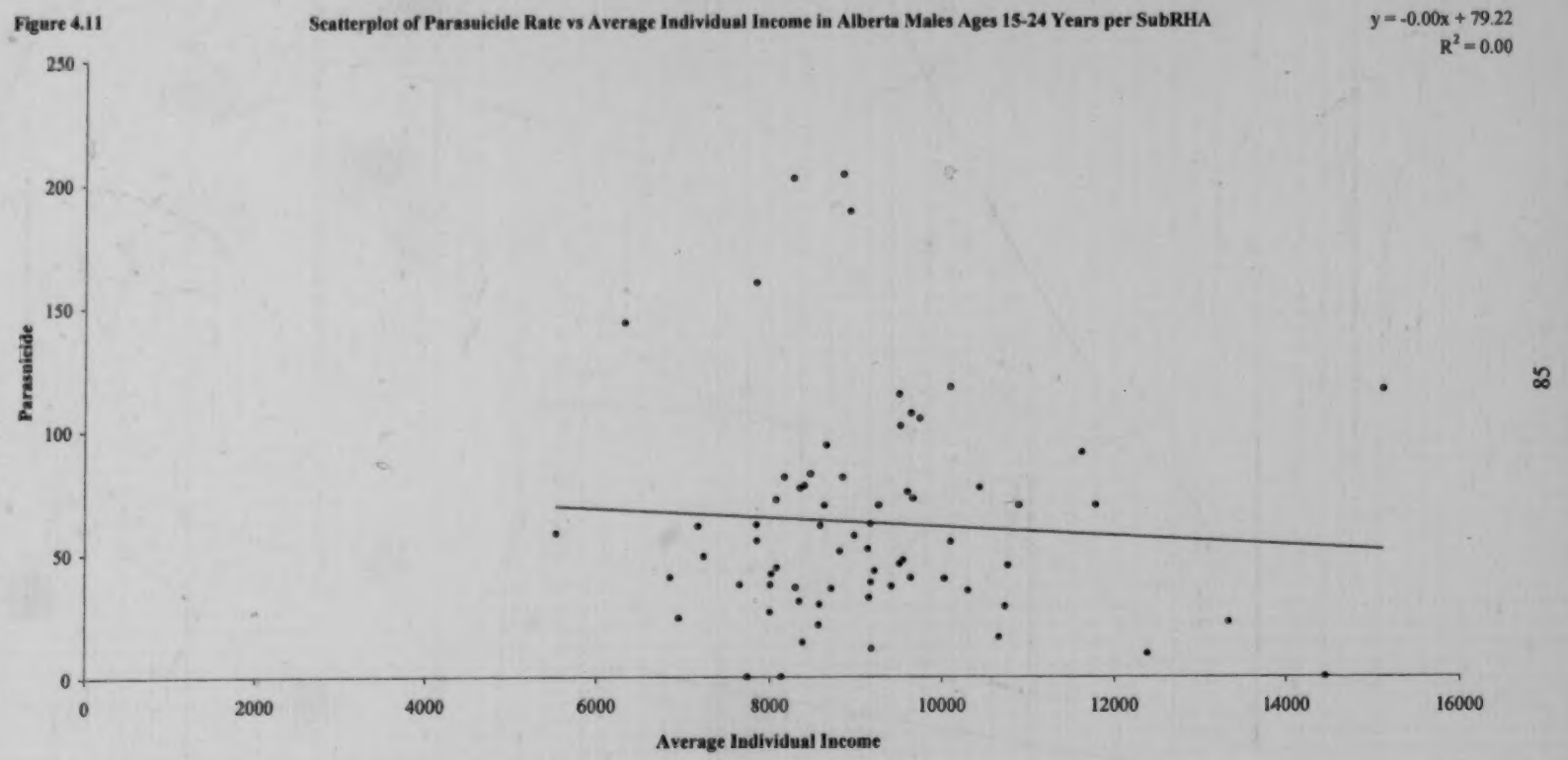


Figure 4.12 **Scatterplot of Parasuicide Rate vs Average Individual Income in Alberta Females Ages 15-24 Years per SubRHA**

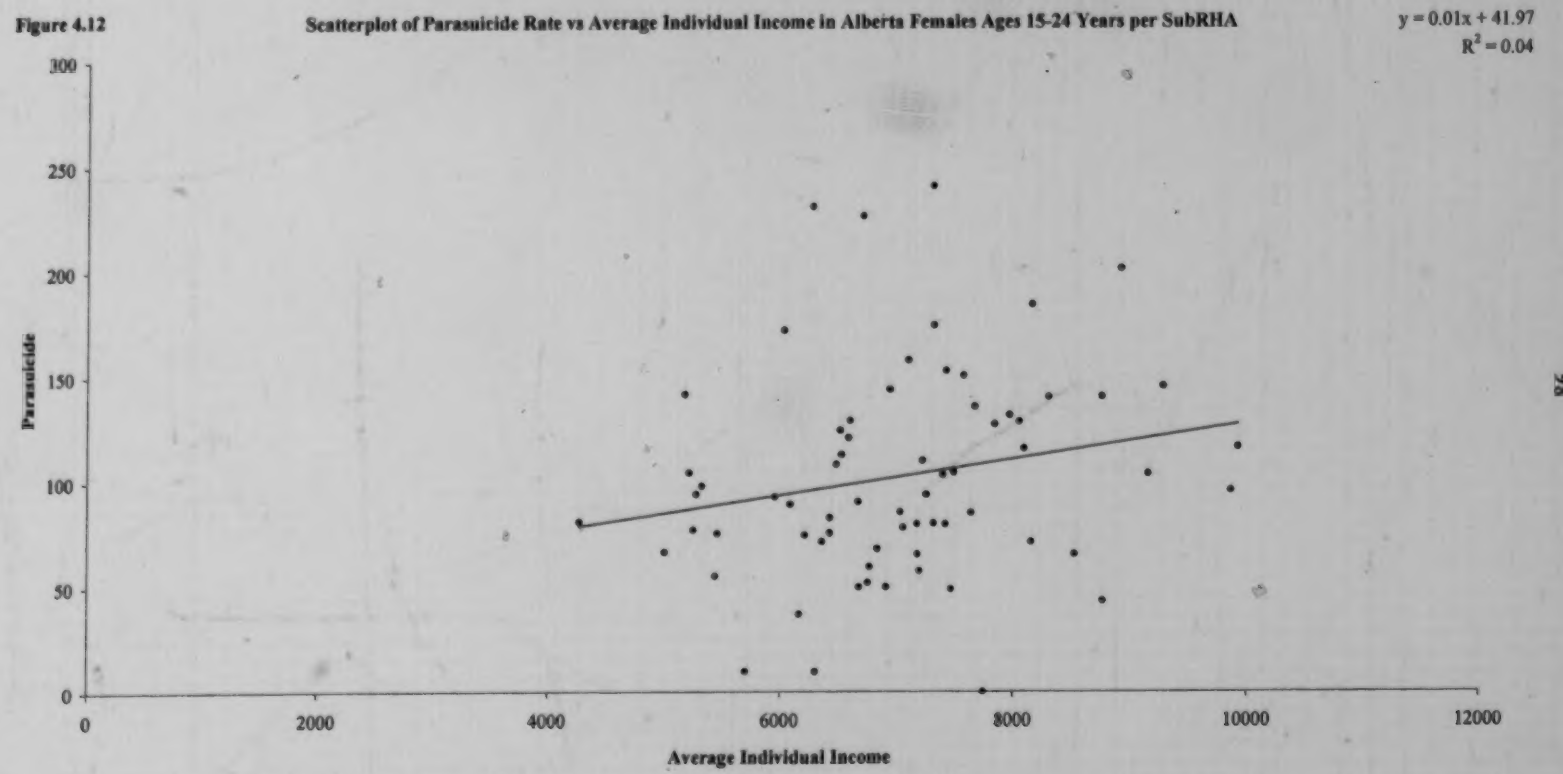


Figure 4.13 Scatterplot of Parasuicide Rate vs Average Individual Income in Males Ages 25 and Older per SubRHA

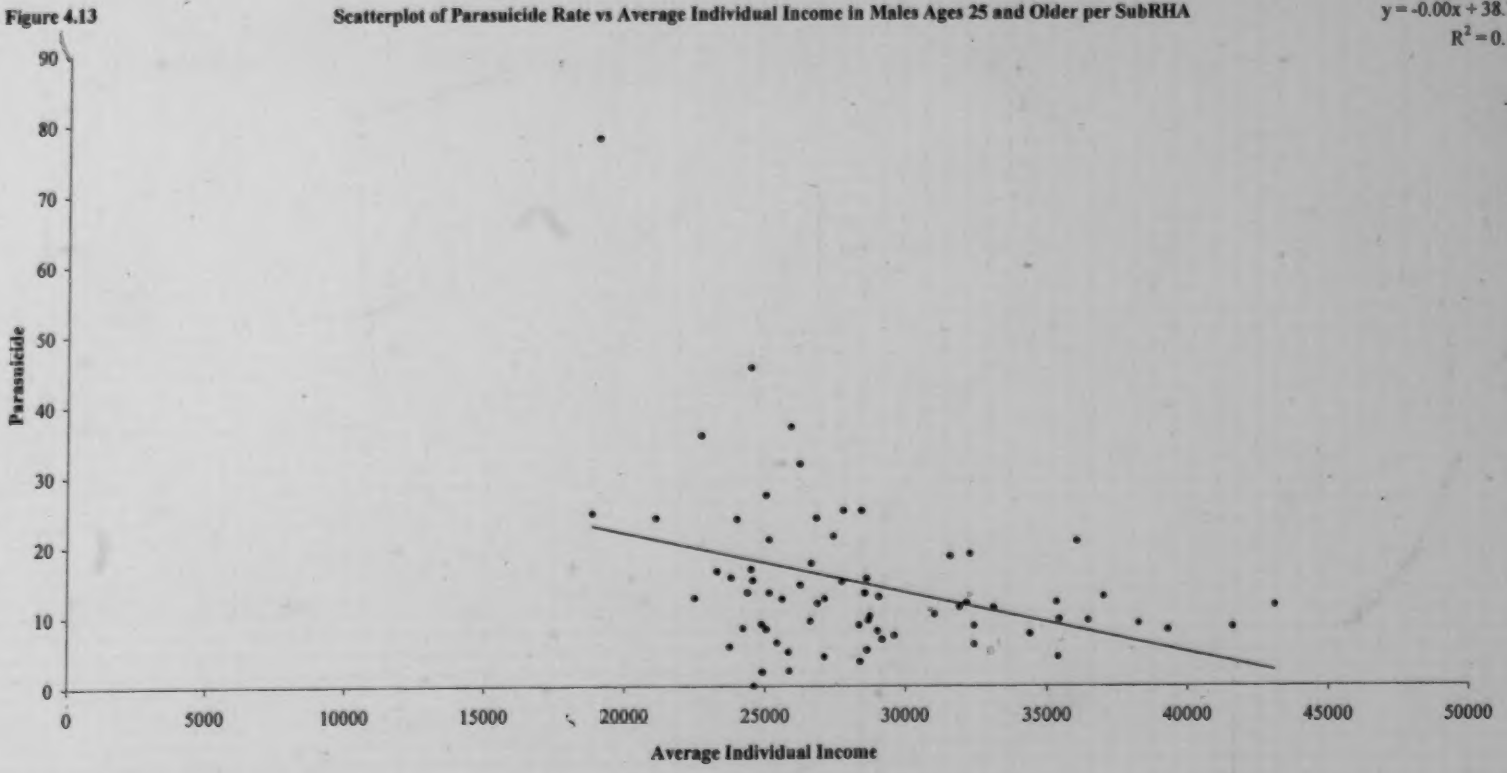


Figure 4.14 **Scatterplot of Parasuicide Rate vs Average Individual Income in Females Ages 25 and Older per SubRHA**

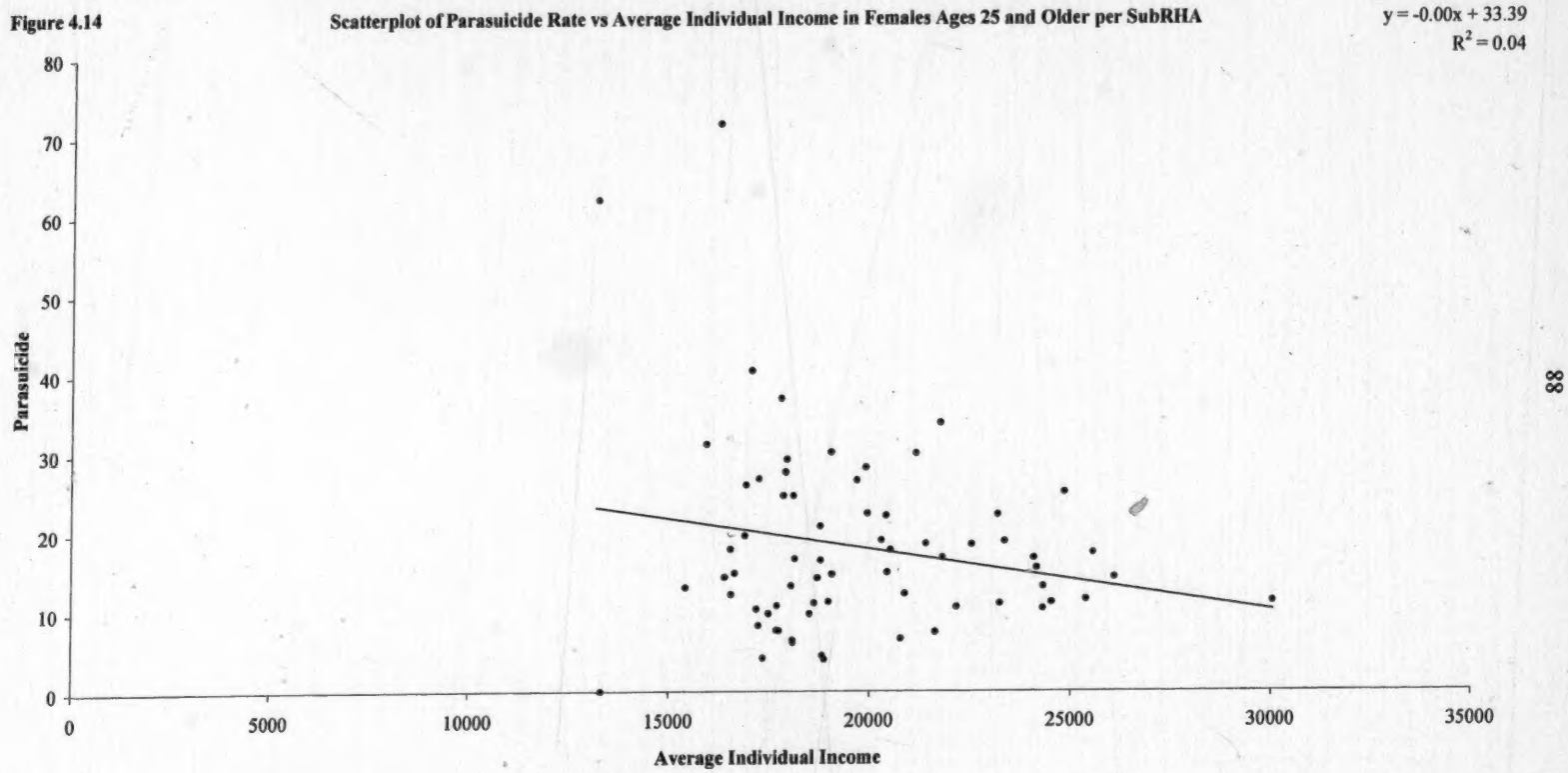


Figure 4.15 **Scatterplot of Less Than Grade Nine Education vs Average Household Income in Alberta per SubRHA**

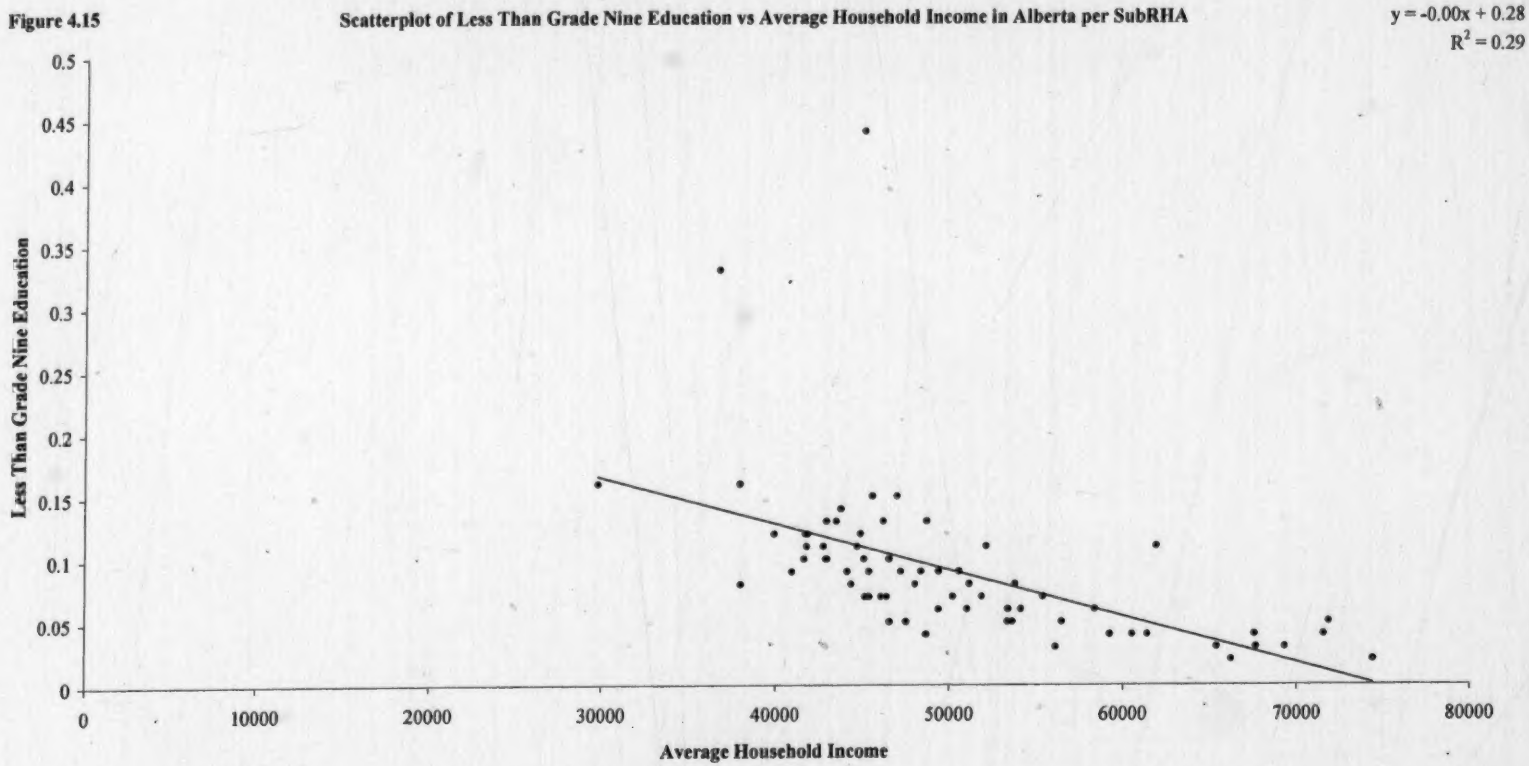
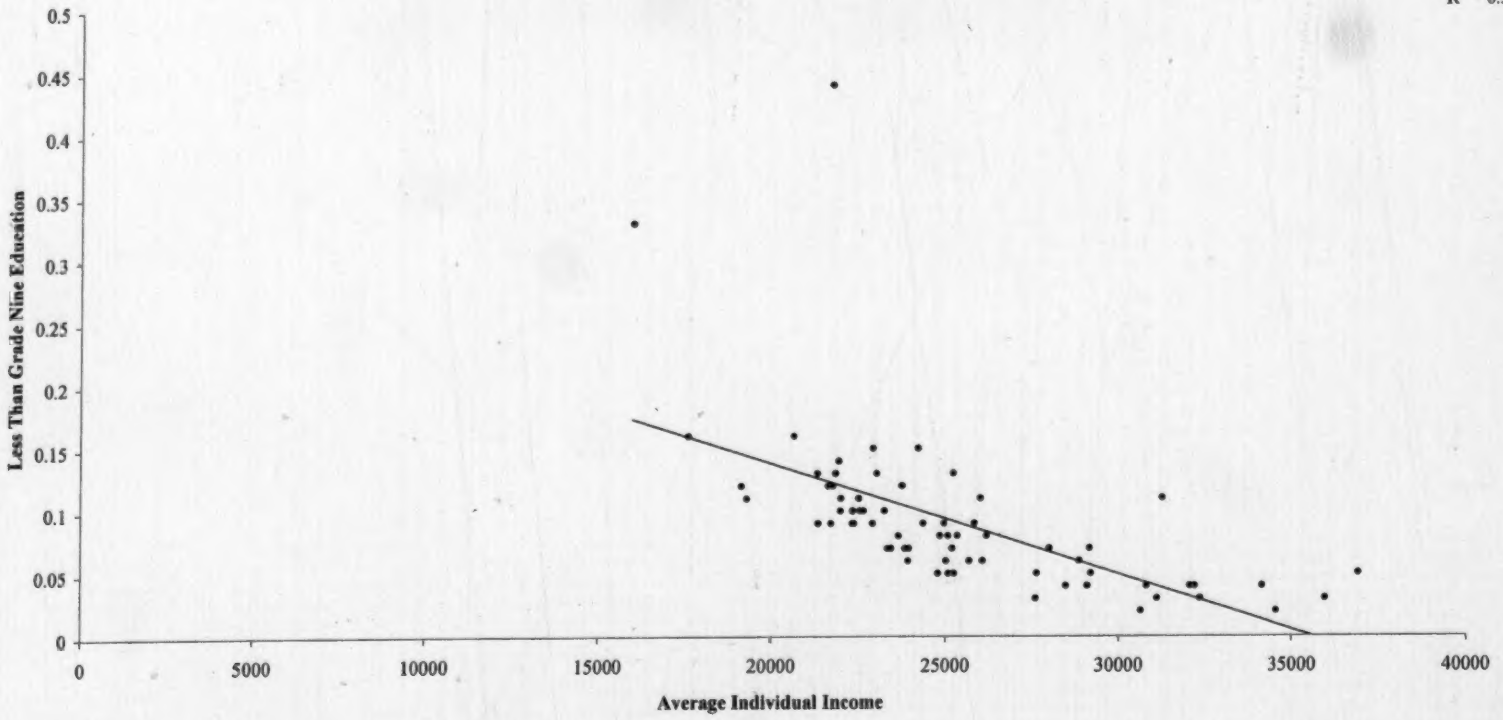


Figure 4.16 **Scatterplot of Less Than Grade Nine Education vs Average Individual Income in Alberta per SubRHA**

$y = -0.00x + 0.32$
$R^2 = 0.36$



Chapter 5 – Discussion

5.1 Review

5.1.1 Comparison With Previous Demographic Findings

As in prior studies of parasuicide, the highest rates were in females aged 15-24, followed by males aged 15-24. The rate for females aged 15-24 was 1.7 times higher than the comparable male parasuicide rate. The relative difference between female and male parasuicide rates in this age group is comparable to what is found in the literature.

In the 25-35 and 35 and older age groups, the parasuicide rates were much lower than in the 15-24 age group and there wasn't as large a difference between genders within a particular age group. The rates for the two older age groups were similar, as is frequently seen in similar age groups in other published studies.

As with other studies of suicide and parasuicide comparing Alberta's two major urban centres, Edmonton and Calgary, Edmonton again had the higher rate. This consistency of higher suicide and parasuicide rates in Edmonton merits investigation. For cities of similar size, culture and demographics to have consistently different parasuicide rates invites curiosity. Newman & Stuart (2005) found that the variation in parasuicide rates in the ecologic units of analysis they reviewed was largely explained by average income and census metropolitan area (Edmonton vs. Calgary). However, Newman & Stuart caution that the high degree of correlation between the sociodemographic variables they examined suggests that "it may not be low income

per se that is affecting the parasuicide rate but, rather, the consequences of belonging to a socially disadvantaged stratum of society".

5.1.2 Comparison with Previous Ecologic Findings

The results of the current study replicate many of the findings in ecologic studies of parasuicide discussed in Chapter 2. Unemployment was found to be very strongly correlated with parasuicide, as were the annual income variables, proportion Aboriginal and variables indicative, at least at face value, of lower socioeconomic status. In most ecologic studies of parasuicide, unemployment was the strongest and most consistent variable correlated with parasuicide, and the current study confirms this. Income has also been shown to be related to parasuicide in previous ecological studies (Newman & Stuart, 2005) but is most often included with other socioeconomic measures (Hawton, et al, 2001; Jarvis et al., 1982), such as social class (Congdon, 1996; Morgan et al., 1975.

Interestingly, some measures identified as being correlated with parasuicide in prior ecologic studies did not correlate with parasuicide in the current study. For example, the proportion of households with six or more residents was not statistically significantly correlated with parasuicide, although previous studies indicated that over-crowding was correlated with parasuicide (Buglass & Duffy, 1978; Daly et al., 1986; Morgan et al., 1975). The difference could be accounted for by the definition of over-crowding, however. In three previous ecologic studies where overcrowding was investigated and found to be statistically significantly related to parasuicide, over-

crowding was defined as greater than 1.5 persons per room. While it seems safe to assume that households with six or more residents would typically meet the 1.5 persons per room criteria, this cannot be guaranteed from the available census data.

As a large number of the studies discussed in Chapter 2 considered populations outside of Alberta and Canada, the similarity of findings compared to the present study lends support to the idea that factors contributing to parasuicide at the ecological level are at least partially universal within North America and Europe.

5.1.3 Interpreting the Results

The final regression equation generated in the results section was:

$$\text{Parasuicide Rate}_{\text{age group-sex adj}} = 21.21 + 23.79(\text{Social Transience}) + 41.82(\text{Overcrowding}) - 28.57(\text{Income} / 100{,}000).$$

As far as one is willing to accept that the sum factor variables accurately represent the underlying construct, it follows from the equation that, within a particular subRHA, as poor social integration and high household density increase and average income decreases, the parasuicide rate increases. This might be conceptualized more succinctly as areas with a poor social climate, coupled with a low average income, have higher parasuicide rates. In light of the literature review in Chapter 2, this is not surprising and fits intuitively with theories of suicide and parasuicide, both ecologic and at the individual-level.

Although this conceptualization of the relationship between parasuicide and sociodemographic measures is very general and ill-defined, it is necessarily so. At this point in parasuicide research, there does not seem to be a predictive relationship between measures, whether ecologic or individual-level, and parasuicide. Certainly, factors such as age and gender have consistent relationships with parasuicide but otherwise, most factors that have been investigated show inconsistent relationships from one study to the next. Mental illness has been shown to have a consistent relationship with parasuicide but this has been primarily investigated at the individual level. While the demographics of parasuicide are consistent across North America and Europe, a review of the literature on parasuicide, including the current study, will serve to highlight both the complexity of the factors contributing to parasuicide and the relatively immature state of parasuicide research.

5.2 Merits of the Current Study

As with any study, the current study has strengths and weaknesses that must be addressed when considering the results. Aside from the comparability to already published work discussed above, this section will outline the advantages and also the limitations of the current study.

5.2.1 Advantages

Of benefit to stakeholders in Alberta is not only that the current study is based on Alberta data but also that the data reflects geographic sub-regions of practical

importance, particularly for health care stakeholders. For Regional Health Authorities, charged with addressing population health concerns and providing publicly funded health care, that the data is based on geographic regions concurrent with their regional geographic boundaries is especially useful.

In the same vein, another advantage of the study at hand is the contribution towards investigating and hopefully understanding, a large public health concern. Parasuicide, both in and of itself and because of its relationship with suicide, is a large public health concern, particularly in Edmonton, and Alberta as a whole, where parasuicide rates tend to be among the highest in those areas of Western world.

In terms of the data itself, the coverage of cases is very complete. Data from the ACCS system captures all emergency department visits in Alberta and, as far as the definition of parasuicide used in the present study goes, captures all cases of parasuicide reporting to emergency departments.

The use of principal components as part of the analysis allowed variables to contribute while taking into account correlations between those variables. Many variables that correlated highly with parasuicide were not retained in the initial linear regressions, due to correlations with other variables. The principal components analysis also allows for greater clarity in identifying possible constructs underlying the predictor variables, although the understanding the meaning of the underlying constructs is not always straightforward. Although it may be difficult to conceptualize

underlying constructs in a concrete manner, it seems unlikely that any one measure – particularly a census measure – will fully capture and predict parasuicide. The causes of parasuicide are likely quite varied, as is suggested by multiple factors in the principal components analysis. Thus, it seems as though identifying possible underlying constructs and investigating these constructs further is the best path towards better understanding and predicting parasuicide, particularly at the ecologic level. The most salient example of this is unemployment. As has been mentioned several times, unemployment was consistently the strongest factor related to parasuicide in prior ecologic studies. This was also found in the current study at first glance, but the results of the principal components analysis suggests that unemployment may not be directly predictive of parasuicide of its own merit but rather is representing a number of other factors or constructs that are more directly related to parasuicide.

5.2.2 Limitations

As is common in ecological studies, a large number of the census variables correlated with parasuicide and, as discussed in Chapter 4, many of the census variables were highly correlated with each other. Although this is not a limitation, in the sense that the data reflect complex relationships, these relationships can present difficulties for analysis. Specifically, these relationships can cause unreliable B coefficients in regression models, leading to misleading conclusions of relative importance of contributing variables. Steps, were taken – namely, the principal components analysis – to reduce the muddying effects of the intercorrelations and

provide a clearer understanding, however, the resulting factors are open to interpretation as to the underlying construct they might represent. As was mentioned in Chapter 4, it seemed as though the underlying three factors that represented the entire variable set could be thought of as Social Transience, Overcrowding and Income.

As the parasuicide cases were collected from an administrative database, the definition of parasuicide was based upon availability rather than an *a priori* set of criteria. The potential for miscoding diagnoses is present as determining whether the injury was self-inflicted can be difficult, particularly in the hectic environment of the emergency department. In addition, cases not presenting to emergency were not available for inclusion, thus the parasuicide rates presented in the current study likely underestimate true parasuicide rates. As has been mentioned previously, it has been suggested that the majority of parasuicide cases are not hospitalized (Bland et al., 1998).

Due to privacy considerations as per Alberta's Health Information Act, the data released by Alberta Health and Wellness were aggregated into three age groups: 15-24, 25-34 and 35 and older. As a result of the nature of parasuicide, parasuicides in individuals over 35 are relatively infrequent and any smaller age groupings for those 35 and older would result in very small cell sizes, particularly when gender is provided. While privacy considerations are necessary, the 35 and older age category does not allow for any analysis of parasuicides among individuals or age groups above

35. From the literature, it can be expected that the 35 and older age category was not homogenous throughout with respect to parasuicide rates.

The current study was typical of many other ecologic studies of parasuicide in that temporal considerations were not considered. Although the census variables in the current study were collected in 1996, and thus precede the parasuicide cases, a direct relationship cannot be claimed. If the census and parasuicide data were available for a number of consecutive years, temporal considerations at the ecologic level could be addressed. This will be discussed further in section 5.4.

In addition, cases of parasuicide that later died in the ED or in an adjacent hospitalization were not excluded, although the numbers presenting to ED would be expected to be relatively small compared with the almost 5,500 parasuicides in Alberta each year, since there are less than 500 completed suicides in Alberta in a year and most are due to firearms and hangings (Office of the Chief Medical Examiner, 2003). Thus, some parasuicide cases could have been considered completed suicides. However, whether this is a limitation or not depends on the accepted definitions of suicide and parasuicide. For example, consider an individual engaging in self-harm behaviour, without the intent to die, but who did in fact die as a result of the self-harm behaviour. Would this be considered an act of parasuicide that resulted in accidental death or would this be considered a suicide? The definition of parasuicide in Chapter 2 defines parasuicide as an act with a non-fatal outcome but does not indicate whether outcomes are to be considered in the immediate or longer-term. As another, perhaps

hyperbolic and rhetorical example to illustrate the importance of this, consider an individual who cut their wrists, regardless of intent to die, and as a result died from an infection obtained in hospital, rather than blood loss, some weeks later. In what category would this case be placed? Although intent of parasuicidal behaviour is left out of the definition of parasuicide, for what seem like practical reasons, intent plays a large part and ought to be considered in future research.

5.2.3 Analytical Considerations

Since the definition of parasuicide cases in the current study is based on emergency department visits and the ACCS database contains all cases, it could be argued that the parasuicide rates presented are not a sample, per se, and do not require statistical methods to determine differences between groups. For example, we do not need to use statistical methods to determine whether the males aged 25-34 parasuicide rate was different from the females aged 25-34 rate. Since we are dealing with all cases of parasuicide and are considering this rate based on the entire corresponding population, any difference in rates is genuine and taking into account sampling error is unnecessary. That said, whether any differences between groups are of practical significance is another concern. Of course, there will inevitably be data capture errors in any data collection system that may be considered random, so statistical methods can still be considered appropriate.

5.2.4 Ecologic Fallacy

No ecologic paper would be complete without mention of the ecologic fallacy. The current study considers measures representing numbers of individuals within a particular geographic area and as such, and relationships between these measures seen at the ecologic level cannot be said to be necessarily present at the individual level.

That said, some individual level research suggests that for certain measures, such as unemployment (Beautrais et al., 1998), the direction of the associations of those measures with parasuicide are in the same direction, although not necessarily similar in magnitude.

In the current study, there are a number of interesting ecological relationships. The correlation between the parasuicide rate and the unemployment rate is statistically significant and has the highest coefficient (0.75, $p < 0.01$). Although it may not be appropriate to assume that this ecological relationship is present at the individual level, that is to say that unemployed individuals are at a greater risk for parasuicide, this may genuinely be the case. It could also be a more complex relationship such that the risk of parasuicide is elevated among unemployed individuals but that a high unemployment rate could also lead to increased risk of a similar or different magnitude for employed individuals.

The next most highly correlated census variable with parasuicide is the proportion of Aboriginal individuals (0.53, $p < 0.01$). It seems quite likely that being

Aboriginal puts one at a greater risk for parasuicide given that the proportion of Aboriginal individuals is also significantly positively correlated with a number of other census variables indicating social disadvantage such as, the proportion with less than a grade nine education, the proportion of households with six or more residents, multifamily households, unemployment rate, and is negatively correlated with average income measures.

The strong relationship between variables contributing to the Social Transience factor look to suggest that being separated or divorced, living alone, living in an apartment, having moved in the previous year, renting, and being an immigrant results in an increased risk of parasuicide and that having more than one of these concurrently further increases risk. It is not difficult to conceptualize these factors as going hand-in-hand at the individual level and being responsible for an increased risk of parasuicide.

5.3.1 Comments

Having already discussed how the current study relates to previous work, as well as its advantages and limitations, it seems worthwhile to consider the implications the current study suggests. Ecological studies such as the present one are not ideal for elucidating cause and effect conclusions but are very useful as a relatively inexpensive means of understanding the magnitude of a topic of interest in a particular population and for developing informed hypotheses.

Broadly, the analysis seems to add support to Newman and Stuart's (2005) reminder that "it may not be low income per se that is affecting the parasuicide rate but, rather, the consequences of belonging to a socially disadvantaged stratum of society". This suggestion is not necessarily new but is a succinct way of applying Durkheim's theories of egoistic and anomic suicide in terms of parasuicide. Being socially disadvantaged may encompass a number of circumstances, such as poor social integration, poor living conditions and low income. Assuming that parasuicide is a behaviour that is the result of factors external to a person, it seems unlikely that any one factor will cause an individual to engage in parasuicidal behaviour in the majority of cases but rather is the result of a number of factors in tandem operating over a period of time. Ecologically, the regression equation containing the three factors identified in the principal components analysis suggests something similar; that parasuicide rates in a particular sub-RHA are highest when Social Transience and Overcrowding (each suggesting a socially disadvantaged sub-RHA) are high and Income (suggesting economic prosperity) is low. Of course, there are certainly cases of parasuicide due to an impulsive reaction to a single event or condition.

Obviously, parasuicide is not due exclusively to factors external to a person but also to factors within a person, specifically mental illness, which typically has a strong genetic component. This serves to highlight that using variables indicating social disadvantage to predict parasuicide in a cause-and-effect sense may be misleading in many instances. Mental illness can be responsible for both belonging to a socially disadvantaged stratum of society and for parasuicidal behaviour. From this, it would

be interesting to see how parasuicide intent – failed suicides versus self-harm behaviour without the intent to die – is related to the temporal onsets of mental illness and social disadvantage. Also worth considering but difficult to determine, is why one individual engages in parasuicide while another person does not, despite similar situations. Or why one person impulsively reacts to an event, while another requires a prolonged exposure.

At any rate, the causes of parasuicide are likely extremely complex, with contributing factors possibly related in feedback loops, reinforcing and worsening each other. For example, in some cases, being socially disadvantaged may lead a person to develop a mental illness and in other cases, being mentally ill may lead to a person becoming socially disadvantaged. Over time, the situation can worsen as the mental illness furthers the social disadvantage and the social disadvantage furthers the mental illness, until the situation becomes salient enough that an individual may exhibit parasuicidal behaviour, which as defined by Platt (1992), "is aimed at realizing changes which the subject desired via the actual or expected physical consequences".

Perhaps, the best method of predicting parasuicide is a scale, either individually or ecologically, with the appropriate variables, each representing known underlying constructs and each properly weighted to represent the relative contribution of factors, both internal and external, towards parasuicide. Such a scale would only be concerned with the current saliency of the situation and how it will affect the tendency

towards parasuicide. In terms of understanding the causes of parasuicide, a time component must also be considered in addition to other variables.

5.3.2 Policy Implications

For policy makers, a precise understanding of the exact relationships between parasuicide and factors at the individual and ecologic levels is unnecessary. From the results of the current study and the others discussed above, areas that tend to score highly on indices of social disadvantage clearly tend to have high parasuicide rates. Furthermore, regardless of whether ecological variables that are shown to be related to parasuicide at the ecologic level represent the aggregation of individual characteristics or whether they represent group-level constructs, it is clear that parasuicide is related to social disadvantage and inequality. Being mindful of the ecologic fallacy, it is also very plausible to suggest that individuals that would score high on indices measuring social disadvantage would be at increased risk of parasuicide. It seems likely that this relationship would extend beyond parasuicide and could be shown in other health outcomes.

At any rate, it seems unlikely that dealing with any one factor shown to be related to parasuicide will have a large impact on reducing parasuicide. Taking steps towards reducing inequality and social disadvantage as a whole, at both the population and individual level, appears to be the best approach for reducing parasuicide, suicide and other socially-influenced negative health outcomes. For example, dealing with unemployment by creating a number of low paying and non-skilled jobs would be

unlikely to reduce other factors such as low income, poor living conditions, low education and poor prospects for the future, and thus would not reduce parasuicide by a large degree. In addition, treating parasuicide victims by improving access to appropriate treatment may reduce repeat parasuicide behaviour but would not address the root causes of the behaviour.

Only by creating a social environment that contributes to the wellbeing of all individuals and ensuring that appropriate treatment is available can policy makers expect to positively impact parasuicide, suicide and other health outcomes.

5.4 Future Research

Future research addressing the shortcomings of the current study as discussed in 5.2.2, the shortcomings of other studies on parasuicide and the considerations mentioned in 5.3 is important. As mentioned above, considering the burden of suicide and parasuicide, particularly in Alberta, future research would have very real potential to address this serious population health issue.

Including psychiatric variables would also benefit future research. Although mental illness is not as frequently seen in parasuicide as in suicide, mental illness is an often overlooked consideration in studies of parasuicide. Understanding the relationship between parasuicide and mental illness would be valuable for developing programs to reduce parasuicide, particularly with regards to repeat parasuicide and parasuicide leading to eventual suicide.

The most pressing need for future research, in terms of public health, is studies designed to determine causal relationships between parasuicide and its contributing factors. Determining not only the factors related to parasuicide but also the factors that lead to parasuicide would be a great step towards being in a position to implement programs with a strong chance of making an impact on parasuicide. Necessary for determining causality are temporal considerations, which are too often left out of ecologic studies of parasuicide. Future research designed to include extended periods of consecutive observation, with fine enough temporal intervals to detect subtle rate fluctuations, and methods of analysis to deal with such data would be very valuable in terms of understanding factors that lead to parasuicide at the ecologic level.

As with all ecologic studies, one is confined to commenting on groups of individuals. That said, consistency of findings in numerous ecologic studies, across varying geographies, would provide individual-level studies with an excellent starting point when considering measures to investigate. Obtaining all cases of parasuicide would obviously be difficult, however, it would be feasible to have researchers monitor parasuicide cases as they present for medical attention, as in the WHO/EURO Multicentre Study (1992) mentioned in Chapter 2. From there, researchers can solicit study participation from individuals while the event is still recent and the most accurate data is likely to be gathered. It might even be worthwhile to consider including parasuicide within larger prospective cohort studies investigating another topic, particularly topics related to mental illness, if a prospective cohort study

investigating parasuicide is not independently feasible. The demographic variables collected for analysis with the other topic would likely be useful in studying parasuicide at the individual level. Of potential benefit would be to incorporate administrative databases in individual level studies by linking survey results from studies with outcomes and health services utilization obtained from administrative databases.

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